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# *AGNOCORIS RUBICUNDA* IN NORTH AMERICA (Hemiptera, Miridae)[1]

THOMAS E. MOORE
Illinois Natural History Survey, Urbana

In 1952, Wagner and Slater established the name *Agnocoris pulverulenta* (Uhler) as the proper one for our most common eastern species of this genus and suggested that the "true *rubicundus* may be present in the western United States, where it has been recognized under the varietal name *winnipegensis* Knight." Through the kindness of Dr. H. H. Knight I have recently received several specimens of this genus, including specimens of his variety *winnipegensis*. All of the material of this variety that I received properly belongs under the name *rubicunda* (Fallén), the first valid North American records of this truly Holarctic species. A summary of the locality and host data for this material follows.

*Agnocoris rubicunda* (Fallén)

Moscow, Idaho, April 15, 1932, T. A. Brindley, on willow, 1 ♂; April 25, 1932, T. A. Brindley, on willow, 1 ♂; May 28, 1932, T. A. Brindley, 1 ♀. Edmonton, April 26, 1924, O. B., on willow, 1 ♂; May 7, 1924, O. Bryant, 1 ♂. Kl. Machnow [near Berlin, Germany], April 25, Weide, 632, 2 ♂, 1 ♀.

Except for the apparently faded condition of the female from the last locality, all of these specimens were much redder than any others of this genus that I have seen. "Brick red" seems to be an acceptable term to describe this coloration.

*Agnocoris pulverulenta* (Uhler)

St. Anthony Park [St. Paul], Minnesota, July 9, 1923, H. H. Knight collected at electric light, 1 ♂. Batavia, New York, July 22, 1913, H. H. Knight, 1 ♂; July 19, 1916, H. H. Knight, 4 ♂. Ithaca, New York, September 23, 1916, H. H. Knight, 1 ♂, 1 ♀.

*Agnocoris rossi* Moore

Wharton, Texas, June 24, 1917, H. H. Knight, 2 ♂. Zion Canyon, Utah, Vasco M. Tanner, 1 ♂.

*Agnocoris utahensis* Moore

Jemez Springs, New Mexico, May 25, 1915, Woodgate, 1 ♂.

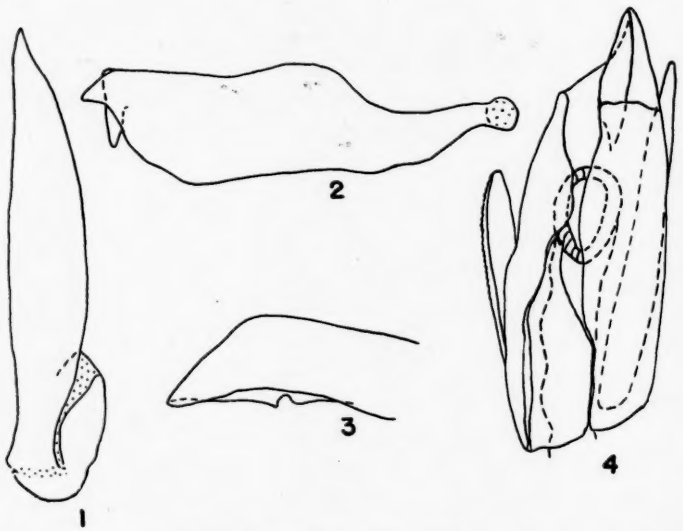
Discovery of *rubicunda* in North America invalidates the second couplet in the key recently presented (Moore, 1955). Therefore, a revised key to the known species in this genus is presented, using structural characters in each couplet. Illustrations of the male genitalia of the other three Nearctic

[1] This paper is a joint contribution of the Section of Faunistic Surveys and Insect Identification, Illinois State Natural History Survey, and the Department of Entomology, University of Illinois.

species can be found in the paper mentioned above. No specimens of *A. reclairei* (Wagner) were available to me, so placement here is based upon the reference cited in the key and the original description.

## KEY TO MALES OF *AGNOCORIS*

1. Shaft of vesica appendage much wider at middle than at its base (fig. 1); general color brick red ..... *rubicunda*
   Shaft of vesica appendage proportionately shorter and approximately the same width at middle as at base; general color yellow-ocherous, red-brown, or very dark brown ..... 2
2. Apex of left gonoforcep lacking a ventral hook but occasionally with a slight indentation; vesica appendage very attenuate and slender ..... *rossi*
   Apex of left gonoforcep bearing a ventral hook and notch (fig. 3); vesica appendage proportionately shorter and thicker ..... 3
3. Apex of vesica appendage not surpassing top of ring structure around gonopore; apex of right gonoforcep ending in a downward projecting hook ..... *utahensis*




EXPLANATION OF FIGURES

*Agnocoris rubicunda*

FIG. 1. Vesica appendage, viewed from back of aedeagus.
FIG. 2. Right gonoforcep, outer lateral aspect.
FIG. 3. Apex of left gonoforcep, oblique, inner lateral aspect.
FIG. 4. Apex of aedeagus, viewed from open side of gonopore.

Apex of vesica appendage obviously extending past top of ring structure around gonopore (as in fig. 4); apex of right gonoforcep not projected downward hook-like ..... 4

4. Specimens collected in Europe; right gonoforcep with body rectangular and with apex ending in a finger-like inward projecting process; color yellow-ocherous with distinctly reddish cuneus or very dark brown ..... *reclairei** Specimens collected in North America; right gonoforcep with body gradually narrowed basally, apex broadly rounded below, not finger-like; general color light-brown or reddish-brown, cuneus not as above ..... *pulverulenta*

LITERATURE CITED

Wagner, E. and J. A. Slater 1952. Concerning some Holarctic Miridae (Hemiptera, Heteroptera). Proc. Ent. Soc. Wash., 54: 273-281.

Moore, Thomas E. 1955. A new species of *Agnocoris* from Illinois, and a synopsis of the genus in North America (Hemiptera, Miridae). Proc. Ent. Soc. Wash., 57: 175-180.

*Figure E, plate I, p. 275, in Wagner and Slater (1952) appears to be an oblique ventral aspect and fig. H of the same plate shows a strong basal construction which is not present on any specimen examined by the author. Specimens of this species were received after this paper was submitted.

# A NEW *CENOCORIXA* FROM THE NORTHWESTERN UNITED STATES (HEMIPTERA-CORIXIDAE)

H. B. HUNGERFORD[1]

DISTRIBUTIONAL CHART OF CENORIXA

| | U. S. A. | | | | | | | | | | | | | | | | | | Canada | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Calif. | Oregon | Wash. | Idaho | Nevada | Arizona | Utah | Wyoming | Montana | N. Dak. | S. Dak. | Colorado | N. Mexico | Texas | Kansas | Minnesota | Iowa | Illinois | R. I. | B. Col. | N. W. T. | Alberta | Sask. | Manitoba |
| sorensoni | | | | | | | x | | | | | | | | | | | | | | | | | |
| dakotensis | | | | | | | | | | x | x | | | | | x | | x | | | x | x | x | x |
| bifida | x | | | x | | | x | x | x | x | | x | | | | x | | | x | x | | x | x | x |
| kuiterti | x | | | | | | x | | | | | | | | | | | | | | | | | |
| andersoni | | x | x | | | | | | | | | | | | | | | | | | | | | |
| blaisdelli | x | | | | | | | | | | | | | | | | | | | | | | | |
| expleta | | | | | | | | | | x | x | x | | | | | | | | | | | x | x |
| wileyi | x | x | x | | x | x | x | | | | | x | x | | | | | | | | | | | |
| utahensis | x | x | | | x | x | x | | – | x | x | x | x | x | x | | x | | | | | x | | x |
| malkini | | x | x | | | | | | | | | | | | | | | | | | | | | |

[1] Contribution No. 915 of the Department of Entomology, University of Kansas.

The genus *Cenocorixa* now includes ten species and may be considered a western genus. It is represented by five species in California and Utah, four of them common to the two states. Oregon, Colorado and North Dakota each have four species with only one species in all three states. *Cenocorixa utahensis* (Hungfd.) which has been reported from twelve states (including western Kansas and Iowa) and two Canadian provinces shows quite a wide distribution from California to Iowa. *C. bifida* (Hungfd.) and *C. wileyi* (Hungfd.) also have wide ranges. The former from California to Minnesota with a record from Rhode Island (nine states) and four Canadian provinces. The latter in eight states from California to Colorado and New Mexico.

In 1951 Mr. Borys Malkin sent me three males of a new species from Munsel Lake in Oregon and recently a good series of the same species from Chase Lake in King County, Washington. It is described below.

*Cenocorixa malkini* n. sp.

*Size:* Length 6.72 mm. to 7.15 mm. Width of head across eyes 2.1 to 2.31 mm.

*Color:* General facies dark. Pronotum crossed by eight or nine dark bands that are about equal in width to pale interlineations, the median ones somewhat split or broken, but giving an impression of being a more heavily dark banded species than other members of the genus. Claval pattern irregularly transverse, the dark bands and figures broader than the light figures except on basal third. The corial pattern dark, the dark figures more or less fused into longitudinal series. Membrane and corium plainly separated by a pale line. Embolium smoky except for a dorsal strip in front of the nodal furrow. Head and limbs pale except for the last tarsal segment of the hind leg which is heavily embrowned.

*Structural Characteristics:* Head of male about half as long as pronotal disk; interocular space about the width of an eye; vertex of the male as seen from above slightly produced beyond the margin of the eye; facial hairs few; male fovea broad, almost attaining eyes laterally; antennal segmentation 1:2:3:4::24:18:45:30 ♂; pronotal disk with median carina visible on anterior third; pronotum and clavus plainly rastrate; clavus and corium with scattered long pale hairs; pruinose area of embolar groove posterior to nodal furrow plainly longer than that of claval suture, the shining costal area anterior to the nodal furrow about equal in length to the middle tarsus; lateral lobe of the prothorax longer than broad, sides parallel, tip blunt. Mesoepimera narrow with osteole less than one-third the distance from tip to the bend; metaxyphus about as broad at base as long, apex pointed. Front leg of female, normal with about twenty hairs in lower palmar row. Front leg of male; pala moderately broad, dorsal edge curved inward before the middle, basal carinal ridge half way between peg row and dorsal line; pegs in a single curved row, numbering from 31 to 33 pegs; outside of pala with ridge on basal two-thirds; tibia about two-thirds as long as pala with a sharp dorsal carina; femur of moderate size with 9 or 10 rows of stridulatory pegs on inner surface; hind femur with one long row of stout spines on dorsal surface and some other spines out of line near

Cenocorixa malkini Hungerford

its distal end; relative lengths of leg segments: Middle leg: femur: tibia: tarsus: claw :: 100:57.9:39.5:48.9. Hind leg: femur: tibial: tarsusl: tarsus 2:: 100:100 :127.3: 56.6. Male asymmetry dextral; strigil large of 13 or 14 quite regular comb rows, rear margin of seventh abdominal segment slightly concave. Right clasper pointed at tip, not bifurcate. For details of male pala, abdomen and genitalia see text Figures. Female abdomen with seventh ventral segment broadly incised at tip.

*Comparative notes:* This species would run out in my key on page 564 of The Corixidae of the Western Hemisphere[2] with *C. kuiterti* Hungerford. It differs from that species in having a large strigil, and unforked right clasper, and fewer and heavier black lines on the pronotum.

*Location of types:* Holotype male, allotype female and 1 male and 7 female paratypes labeled "Washington, Chase Lake, Snohomish, 23, VIII, 1954. B. Malkin; also 1 male and 2 female paratypes, 25, IX, 1954, and 4 male and 2 female paratypes, 17, X, 1954, from above places; 13 male and 8 female paratypes labeled, "Chase Lake, Washington VI-1-1953, B. Malkin"; 3 males labeled "Oregon, Florence (Munsel Lake) July 11, 1951, Borys Malkin." Holotype, allotype and some paratypes in University of Kansas, Francis Huntington Snow Museum; others in Malkin's collection.

## USE OF MIRRORS TO DISPLAY BUTTERFLIES

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An assortment of about 1500 beautifully colored "O My!" exotic butterflies of the collection of the late John L. Sperry were recently given to the University of California at Riverside by Mrs. Sperry. In the collection were many highly-marked specimens having the color pattern on the under surface of the wings differing markedly from that of the upper surface. The

[2] Science Bulletin vol. XXXII, 1948.

following method of displaying butterflies was devised in an attempt to show the color-pattern variance of this collection.

The Entomology Department display collection is exhibited in hand-me-down geology specimen display cases and cabinets. The display units are drawers (20 by 26 inches and 4 inches deep) that have been converted into Cornell-type insect display trays.

For displaying the under surfaces of the specimens, the trays are fitted with 4 to 8 strips of mirror. These mirror strips are approximately 18 inches long and from 2 to 5 inches wide, the width depending on the size and number of rows of specimens to be displayed. The space between the strips of mirror is only wide enough for pinning through into the cork below. Figure 1 shows three specimens which are pinned between two 3- by 6-inch mirrors. The mirror strips should be fastened in place to prevent their movement when handling the trays. Pins should be placed at each end of the spaces between the mirrors to keep them separated the proper distance. These trays are displayed at about a 65-degree angle in a glass-covered showcase.

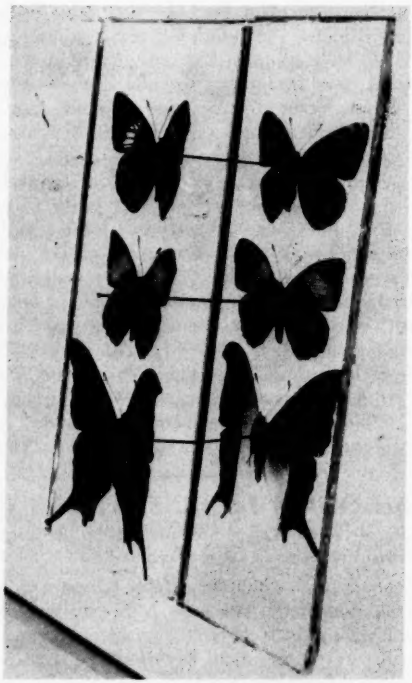

FIG. 1. The use of mirrors to display butterflies: left, direct view of the upper surface of the specimens; right, reflected view of the under surface.

Displaying specimens in this manner not only enhances the appearances of the specimens, but also increases the beauty and apparent size of the collection.

# NOTES ON THE BIOLOGY AND FEEDING HABITS OF *ESENBECKIA INCISURALIS* (SAY)[1]

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Little is known regarding the biology of the American genus *Esenbeckia* Rondani, since this group of tabanids is sparsely represented in the Nearctic fauna north of Mexico. Some species have been reported as flower feeders.

In May and June 1955 the author was so fortunate as to find in Oklahoma *E. incisuralis* (Say)[2] in such abundance that all its stages could be observed. He was directed to the area by Orville C. Schomberg, who had been making collections there for several years in search of *Tabanus sulcifrons* Macq., *equalis* Hine, and *abactor* Philip larvae. He had never before taken larvae or pupae of *incisuralis* and very rarely had seen adults.

Two larvae and the 16-day-old pupae, which were being kept for completion of life cycle to confirm the author's determination, were lost in an automobile accident. Because of the scarcity of information on this genus and in view of the increased interest in the terrestrial habitats of tabanid larvae, it was deemed desirable to publish these notes since the chance for further collections is uncertain.

## LARVAL HABITATS

Seven larvae in two widely separated places in Payne County were collected during late May and early June. The two habitats were similar except for the type of soil, one being rather loose and sandy and the other a very compact clay. In both locations larvae were found in rolling, wooded terrain adjacent to gullies. No standing water would ever be present, as the depressions were sloping to provide excellent drainage. The soil was covered with a thin coat of decaying matter, largely leaves.

In the first habitat an area of loose, sandy soil about 2 yards wide and 10 yards long was examined beginning near the bottom of the draw. Four *sulcifrons* larvae were found in the first 4 yards. The next 4 yards contained one larva and two pupae of *equalis* and four larvae of *incisuralis*. A fifth *incisuralis* larva was found 5 yards farther up the slope. The positions of two of the larvae were observed closely. They were in a vertical position, their heads ½ inch or less from the surface, and in well-formed tunnels that extended from ⅛ inch to 5¼ inches down under the surface. No lateral tunnels could be found. Since the collected larvae showed very little activity in the laboratory, it is believed that these larvae do not move around in the soil as much as do those of several species of *Tabanus*.

[1] Coperative work between the Agricultural Experiment Station, Oklahoma A. & M. College, and the Entomology Research Branch carried out under the guidance of D. E. Howell.

[2] Identification of the adults was confirmed by comparison with a specimen loaned by Cornelius B. Philip of the Rocky Mountain Laboratory, U. S. Public Health Service.

The second habitat, approximately 20 miles east of the first, was on a wooded hillside several hundred yards from the Cimarron River bed. The depression was approximately 25 yards long, 6 feet wide at the bottom, had uniformly sloping banks, and was about 6 feet deep. An area 2 by 8 yards was examined. One *incisuralis* and two *Leucotabanus annulatus* (Say) larvae were found within 3 feet of each other and another *incisuralis* larva 12 feet away. The clay soil was so compact and dry that the clods had to be broken apart with the hands or beaten for thorough examination, even only a few days after a heavy rain. One larva was in a vertical tunnel similar to the others described, and the second was in a horizontal position in less compact soil.

Repeated efforts to collect additional larvae in similar and various other situations in both areas were unfruitful.

### ADULT ACTIVITY

On June 18 both males and females were found feeding on the common wild flower brown-eyed Susan *(Rudbeckia bicolor* Nutt.), which was blooming profusely in an old field adjoining the woods where the first collection of larvae was made. Observations made over a week revealed that feeding began approximately 1½ hours after sunrise, reached a peak at about 10 a.m., and then gradually decreased until an hour or two before sunset, when all activity ceased. When no feeding could be observed, the adults were resting in the field near the ground on weeds and grass. In spite of their agile movements, the author could collect equal numbers of males and females at the rate of one every 3 or 4 minutes during the peak of their activity. Both sexes were frequently seen hovering.

In addition to feeding on flowers, the females attacked cattle. A herd of 28 dairy cattle were pastured a mile from one of the collection points. Three visits to this herd revealed that the flies were not active before 7:30 a.m., were active around the cattle at the rate of two per animal at 10 a.m., and an occasional specimen was noted until sunset. The females hovered about the legs and belly and very reluctantly lit on the upper half of the legs, brisket, and udder. When they landed on the legs and brisket, the wings continued to beat and their feet would appear to slip for a few seconds, as if they had difficulty in establishing a foothold. This peculiarity was not noticed when they landed on the udder. The flies punctured the skin wherever they lit, as evidenced by the actions of the animals. The only flies seen engorging were on the udder, especially the teats. The flies lit and fed with the head up, in contrast to the head-down position typical of tabanids.

During the midmorning visit females as well as males were feeding on flowers a few yards from the cattle. One bite on a man at 11 a.m. was reported from the same area.

At 9 a.m. one pair of adults was observed copulating. They were on the ground among the flowers with the tips of their abdomens in contact and their heads facing opposite directions. The act was terminated when they were disturbed during an attempt to place a net over them.

### EGGS

Twelve females were captured from flowers and placed in an oviposition

cage. Two apparently normal egg masses were deposited, and four individuals deposited a few eggs after they were down on their backs, the position in which they died. The masses were oval, about 8 by 13 mm., and pale yellow. The eggs did not darken with age, but they did not hatch, perhaps owing to infertility. The individual eggs were typical of tabanid eggs in shape and were approximately 0.3 mm. in diameter and 2.5 mm. long. They were deposited on end in a single layer and at a 45-degree angle to the surface. One mass contained 276 eggs and the other 313. One female was watched during part of the process. In contrast to the head-down position of other tabanids observed, while ovipositing she stood on a vertical surface with the head up. One egg was expelled every 25 seconds.

### LARVA

This larval description was made from two preserved specimens in the author's collection: Full-grown larvae, creamy white; 3.5 to 5 mm. in diameter when measured across the last two abdominal segments and the protuberances of the first five abdominal segments; 34 to 40 mm. in length; anal segment very short and rounded.

The more obvious features of the larvae which are different from typical tabanids are given below.[3]

*Head:* Usually retracted into the thorax and seldom seen in live larvae kept in the laboratory. Mandibles dark brown and practically straight in contrast to the typically recurved mandibles of *Tabanus*. Terminal antennal segment thin and short, being approximately one-fourth the diameter and one-sixth the length of the second segment.

*Abdomen:* Each of the first five abdominal segments with two pairs of protuberances or prolegs, one lateral and one ventral; a raised area crossing the dorsal side joining the lateral pair; segments widest across this area and taper sharply to posterior edge. Sixth and seventh segments almost parallel-sided without prolegs. Anal segment approximately one-fourth the length of the preceding segment and semi-spherical, the only break in uniform curvature being the lobes surrounding the anus. Spiracle rigid and oval with the typical vertical slit, not protruding beyond the surrounding area.

*Integument:* Body characterized by longitudinal striations except in certain dull areas, with a pattern faintly resembling a honeycomb or scales on a fish, located as follows: Collar encircling the prothorax from the anterior end and extending posteriorly two-thirds the length of the segment with a sinuous posterior edge; mesothorax and metathorax each with a band around the anterior edge; a narrow band surrounds the intersegmental membranes between the fifth and sixth and the sexth and seventh segments; a distinctly wider band between the seventh and anal segment; narrow ring around the anal lobes and spiracle.

### PUPA

One larva found in a burrow on June 13 pupated in the same burrow the following night. The pupa was of a light straw color, and 25 mm. in length.

[3] For a detailed description of a tabanid larva see J. L. Webb and R. W. Wells, Horseflies: Biologies and relation to Western agriculture. U. S. Dept. Agr. Bul. 1318. 1924.

It superficially resembled pupae of the genus *Tabanus* except for the elongate and prominent frontal carina.

*Head and thorax:* Antennae thick, overlying eyes anteriorly; short, blunt, raised area on each antenna at base of third segment; portion of antenna forward of this projection ringed with five distinct ridges. Carina between, joined to, and raised above antennae; divided medially by a groove; two pairs of prominent forward projections: the dorsal pair tapering to a sharp point, each projection bearing one straw-colored seta on lateral side about two-thirds the distance from the base and extending beyond the tip of the projection; the other pair slightly ventrad with blunt ends; laterally to and on a common tubercle with this pair a third set of tubercles which taper to a point and half the length of the counterparts. Ventrad and slightly lateral to carina: two pairs of broad, wrinkled tubercles which taper to a point and about equal in length to lateral projection of carina, each one bearing a long seta on inside of upper tubercle and ventral side of lower tubercle. Other paired and much less prominent tubercles bearing setae as follows: posterior to antenna, one seta; ventral to antenna, two setae; laterally behind the inconspicuous thoracic spiracle, two setae; dorsally from the last three pairs of tubercles, one seta each; four pairs on sclerite immediately anterior to first abdominal segment: three median pairs with one seta each and lateral pair with two seta.

*Abdomen:* First segment with 12 spines, three on each side separated but near spiracle and three sublateral. Segments 2 to 7 each with two rows of spines circling the body near posterior third (spines absent dorsally on second segment), first row short and varying in length and second row 5 to 15 times longer; spines progressively longer from second to seventh segments. Anal segment bearing a row of short spines on each dorso- to ventrolateral area. Prominent anal aster consisting of two pairs of projections: the main pair parallel and extending posteriorly and slightly curved ventrally; and smaller pair under, branched from the base of, and extending ventrad of the large pair.

## SUMMARY

Observations were made on all stages of *Esenbeckia incisuralis* (Say) in Payne County, Oklahoma, during June 1955.

Adults of both sexes were feeding on flowers of brown-eyed Susan, *Rudbeckia bicolor* Nutt., from early morning until late afternoon. In the presence of both cattle and brown-eyed Susan, most of the females were feeding or attempting to feed on the cattle.

Larvae were collected in well-drained wooded areas adjacent to gullies in association with or very near *Tabanus sulcifrons* Macq., *equalis* Hine, and *Leucotobanus annulatus* (Say).

Two egg masses, containing 276 and 313 eggs, were deposited by caged females.

Full-grown larvae are creamy white, 3.5 to 5 mm. in diameter and 34 to 40 mm. long. The anal segment is very short and rounded.

The pupa superficially resembles pupae of the genus *Tabanus* except for the elongate and very prominent frontal carina.

The determinations of the larvae and pupa were not confirmed owing to loss of immature forms.

# VARIATIONS IN THE OVIPOSITOR OF A WINGLESS COCKROACH, *EURYCOTIS FLORIDANA* (F. Walker)[1,2]

FRED A. LAWSON[3]
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The Large Florida roach, *Eurycotis floridana* (F. Walker), is a heavy-bodied, wingless member of the subfamily Blattinae. Better known species in this group are the fully winged American roach, *Periplaneta americana* Linn., and the partially winged Oriental roach, *Blatta orientalis* Linn. While examining these three species for characteristics which might correlate with the different wing conditions, it was observed that the ovipositor of *E. floridana* differs considerably from other common Blattine roaches. Basically, the "divided subgenital plate," ovipositor, and oothecal characteristics are Blattine in nature. The differences are worthy of consideration however, since the American and Oriental species are so frequently chosen to represent the "typical" cockroach ovipositor.

The Blattid female reproductive apparatus consists of an ovipositor with three pairs of fingerlike lobes or valvulae (Fig. 5, *1, 2, 3 vlv)*, two flat dorsal plates (Fig. 5, *PspP)* bordering a smaller median plate (Fig. 5, *SpP)* which bears the spermathecal papilla and pore, and a flat plate (Fig. 6, *GpPl)* with a median slit-like gonopore. The entire apparatus is enclosed within a pocket composed of combined genital and oothecal chambers. This pocket is closed distally by upward-tending apical lobes (Fig. 3, *7L)* of the seventh abdominal sternite ("divided subgenital plate") and the soft, infolded membrane continuous with them (Fig. 6, *Fo)*. The roof of this chamber is essentially the eighth and ninth intersegmental membranes from which are suspended the ovipositor and the spermathecal plate with its two bordering sclerites. The gonopore-bearing plate represents the eighth abdominal sternite and is reflected caudally and ventrally as the floor of the reproductive pocket. The anterior margin of this piece articulates loosely with the front edges of the dorsal plates which parallel the spermathecal papilla. The floor of the remainder of the pouch is the seventh intersegmental membrane and continues backward to merge with the inside layer of the enclosing sternal lobe tissue. This more posterior part of the pocket functions in the reception of the male reproductive organs and in the fabrication of the egg case.

The ovipositor of *E. floridana* differs from that of the better known Blattines in the following ways: in general disposition of the valvulae; in the structure of the first valvulae; in the development of the spermathecal plate and associated sclerites; and in the development and sclerotization of the gonopore plate. The parts are described in the same order; the corresponding structures of *P. americana* are used whenever necessary for comparative purposes. For more complete descriptions and illustrations of

[1] Contribution No. 656, Department of Entomology. Kansas Agricultural Experiment Station, Manhattan.
[2] This investigation was supported in part by research grant No. RC-4141 (C) from the National Institutes of Health, Public Health Service.
[3] Assistant Professor of Entomology.

the latter species, the reader is referred to Brunet (1951) and Snodgrass (1952); similar material relating to *B. orientalis* may be found in Snodgrass (1933).

### OVIPOSITOR—GENERAL APPEARANCE

The egg-laying and related structures of *E. floridana* (Fig. 5) are noticeably heavier and more gross in general appearance than are the same parts in the two species named above. Additional sclerotization and an increase in size contribute to this. The ovipositor as a whole appears to have been flattened, as if by pressure applied from beneath. This probably is related to the heavier body type and especially to the wider abdomen (Fig. 1). The body of the American roach female (Fig. 2) is lighter and more slender; the ovipositor is more delicately constructed, is suspended comparatively more deeply in the reproductive pocket, and is much more rounded in appearance. The entire apparatus in *E. floridana* is situated more caudad in regard to the tergites than it is in either *B. orientalis* or *P. americana*. The length of the 8th-9th intersegmental fold (9th apodeme of Walker (1919) ) is the indicator of this condition. In the Oriental roach (Snodgrass, 1933) and in the American roach, the apodeme (Fig. 10, *ap)* is a relatively long slender bar inclining forward at a sharp angle; in the Large Florida roach (Fig. 9) it is very short and turns strongly ventrad after leaving the tergal margins. Part of the change in length of the apodeme is taken up by the additional sclerotization around the base of the first valvulae but this does not account for the change of angle at which it leaves the tergal plates. Certain muscles which parallel the fold, likewise, are shortened (c.f. first valvifers).

### THE VALVULAE

The first or ventral valvulae (Fig. 5) are more heavily and more completely sclerotized here than in any other species of the subfamily. The fingerlike distoventral parts, which parallel each other and are mesally contiguous in the assembled, resting ovipositor, are strongly flattened anteriorly and are considerably less membranous in the tip area. The "arm" (that part angling outward and upward toward the valvifer) of each of these valvulae is widened and flattened. The broad ventral surface of this area is set with short, stout setae; these are dense in the apical areas but become sparse antero-ventrally and disappear along the cephalic margin. The arm area narrows distally, via a sharply recurved front margin, into a short, stout, comma-shaped arch. This feature is rounded on its outer face and narrows distally. The distal end curves strongly caudo-dorsad and then blends into a thick plate (Fig. 5, *9StP)* which, according to Snodgrass (1933), represents a part of the ninth sternum. The distal end of the arched portion lies ventrad and slightly cephalad of the ending of the ninth intersegmental groove or apodeme.

The upper anterior margin of the arm portion of the first valvula usually is connected to the roof of the chamber by way of a moderately sclerotic plate (Fig. 9, *Lo)*. This plate arises as a fold along the transverse area of the arm and is reflexed somewhat caudally by means of a sharp crease. A distinct wrinkle, which is more prominent mesally, is thus developed in the anterior

face of the plate. From the top of this fold the sclerite extends cephalad and fades into the non-sclerotized tissues adjoining the edges of the gonopore plates. The sharply folded mesal area of this valve arm plate underlies the antero-lateral margins of the second valvifers and overlies the distal lobes of the paraspermathecal plates. Modifications of this structural feature will be indicated under individual variations.

The valvifer of each first valvula (Fig. 9, *1 vlf*) lies in the angle formed dorsad of the curved bar and cephalad of the inner apodeme termination. Two stout bands of muscle extend to this area from the eighth tergite and make certain the identity of this area (Snodgrass, 1933). The valvifer is reduced in size and is located more caudad in this roach than it is in either *B. orientalis* or *P. americana.*

The ninth apodeme (Fig. 9, *ap)* is a sharply inflected groove, both faces of which are strongly sclerotized; its termination is caudo-dorsad of the valvular ending and is between the valvifer and the ninth sternal plates. The anterior coelomic surface of this apodeme is closely paralleled by the more posterior of the two muscle bundles inserting on the valvifer. From the close association of the muscles, valvifer, and apodeme, it appears reasonable that the latter structure is a flexible, though stout, lever on which the ventral valvula rotates; contraction of the muscle fibers would swing the appendage laterally and ventrally, while the strength and elasticity of the apodeme would tend to return it.

The ninth sternal plates (Fig. 5, *9StP)* lying caudo-mesad of the valvifers are large and may be almost square. They slope strongly inward and slightly downward. The mesal edge normally is marked by a narrow band of white membranous tissue which may be wider in certain asymmetrical specimens. In either case, the non-sclerotic band continues distally, along the mesal margin, a distance of one-half to two-thirds the length of the corner-ridge and then terminates, leaving a narrow sclerotic bridge between the sternal plate and the expanded lobes of the second valvifers (Snodgrass, 1933).

The *third valvulae* (Fig. 5, *3 vlv)* have a noticeably greater depth in relation to their length than is found in the other Blattine species studied. The sides are variably sclerotized with the lower apical margins normally remaining white and unhardened. The distal half of the lower margin, along with the mesally bent tips, encloses the outer and apical parts of the ventral valvulae.

The greatest variation associated with the second and third valvulae is found in the second valvifers. These structures (Fig. 5, *2 vlf*) in other species are usually rounded, bowl-like plates appended to the roof of the cavity. The hollow portion of each valvifer faces upward into the coelom; together they subtend a small cavity through which pass the outlet tubes of the accessory glands before opening into the oothecal chamber. The anterior margin of the valvifer structure usually underlaps slightly the posterior edge of the spermathecal plate. The ventral midline is occupied by a narrow band of non-sclerotic tissue which expands distolaterally and merges with the non-hardened ventral tissues of the second and third valvular lobes. The basal portion of this tissue is folded upward, between the closely approxi-

mated mesal edges of the valvifers, forming a hidden inverted channel reaching backward from a slight up-curved notch in front to the ring-like opening of the accessory gland at the base of the second valvulae. The margin between this soft white tissue and the hardened areas of the valvifers is quite distinct.

The lower front region of each of the second valvifers (Fig. 5, *vlf)* is produced ventrally into a short, stout, bluntly tipped projection. These points are extended ventro-laterally at an angle of about 45° from each other. They extend into that part of the pocket or space which occurs just beyond the distal edges of the para-spermathecal plates. Their normal depth is approximately one-half that of the pocket area in which they occur. They are hollow for most or all of their depth, and usually are filled with fat body and other coelomic material. They are connected mesally by a transverse dorsal bar situated above and across the anterior end of the median slit between the second valvifers. In the lower surface of this bar is found the notch marking the anterior opening of the inverted channel between valvifers. The upper margin may be almost straight, but more frequently is extended upward as an asymmetrical subtriangular point.

Extreme variation in the occurrence of these points and in the degree of production of those present is found among the members of the laboratory culture. The most commonly observed change from the normal bilateral condition is the complete loss of the left-side projection; the other is almost invariably present. When the knob of the left side is missing or reduced, the surface of that valvifer usually is distorted by being flattened, ridged, or variously impressed. The anterior edges frequently are quite heavily sclerotized.

### GONOPORE PLATE

This region, with the narrow transverse underlying strip, constitutes the 8th sternum (Snodgrass, 1933). In *B. orientalis,* this author shows two pairs of smaller plates; these are an inner distal pair lying alongside the gonopore and an outer pair extending backward into the membranous area as short, blunt lateral arms. In *E. floridana,* the entire distal half of the area, except for the narrow center strip through which the common oviduct discharges, is sclerotic and forms a single pair of gonopore plates. A narrow, loop-like sclerotic band is reflected down and forward beneath the apex of the gonopore. A broad, moderately setose plate (Fig. 6, *SePl)* in the otherwise membranous floor of the pocket is situated beneath and caudad of the gonopore opening; it is so located that eggs emerging from the gonopore have to slide across the distally curved hairs.

The arms of the genital plate of the Florida roach are more laterally disposed in the front portion of the plate. They extend caudally as free, horizontally flattened lobes which parallel the sides of the ovipositor. The cephalic extensions are seen as straight bars extending forward from thicker, more heavily sclerotic lateral areas of the plate; the margins of each are sinuate but are not parallel. The tips are bent mesad as very nearly right angles; a wide basal membranous area remains between the tips.

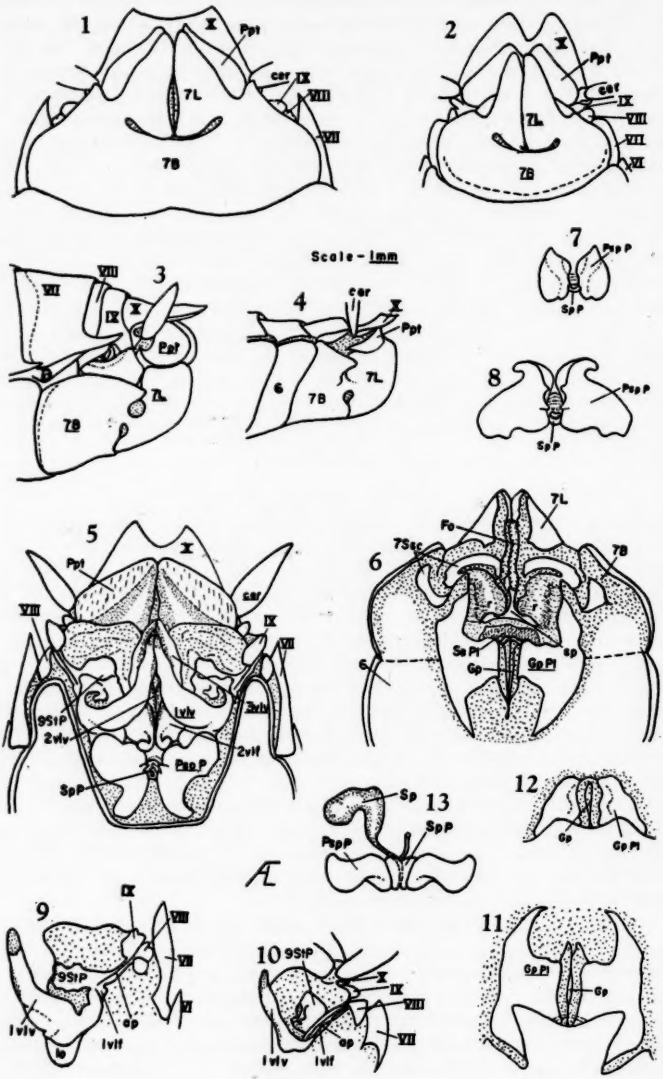
The distal projections of the lateral arms extend back over the infolded seventh sternal tissue lobes. Their mesal margins closely parallel the outside walls of an upraised pocket in this tissue (Fig. 6, *sp*). (The tips of the valvulae are inserted within this pocket when the ovipositor is in the resting position.) The projecting tips of the genital plate arms are strongly sclerotized basally but are less so distally and laterally; the soft apices usually lie near the small seventh sternal sclerites (Fig. 6, 7 *Ssc*). The angle of the mesal margin of the two projections with the caudal margin of the center portion of the gonopore plate is almost exactly 90°. The inner edge of each extension is straight to slightly sinuate; the apex is usually acutely angled but may be slightly blunted. The lateral margin usually becomes membranous a short distance cephalad of the tip. This margin extends cephalolaterally at an angle of 30° to 45°. At a point almost opposite the middle of the free inner margin, the outside edge terminates as a thin tissue merging with the lining of the basal plate of the seventh sternum; this usually occurs about one-third of the distance caudad of the base of this plate. Both surfaces of the apical lobes are set with short, stout spines. These occur densely over the entire lower surface and on the apex and mesal areas of the upper face, but tend to disappear from the middle and outer parts of the upper surface.

### SPERMATHECAL REGION

The spermathecal plate is a roughly triangular piece suspended from the roof and with the broad base caudad. The papillate apical region is blunted across the tip. Sclerotization is light basally and ventrally to very near the tip. The sides of the bluntly pointed cephalic area are bent upward and are heavily sclerotic. From above (within the coelom), the tops of these sides are seen as caudally divergent ribs; the closely approximated front ends almost completely enclose the exit of the spermathecal tubes. The end of the papilla, especially that part around the opening, usually is dark brown to almost black with sclerotization. Very narrow, faintly sclerotic, ribbon-like submarginal bands may extend backward and laterally from the lower corners of the papilla through the thinner basal area. This area is lightly rugose over most of its surface.

The front of the spermathecal papilla is a vertical plate with a deep V-shaped notch in the middle. The sides of the notch are dark brown and strongly sclerotic. The top of the plate changes to membranous and merges with the roof of the cavity, thereby forming the anterior wall of a small pocket lying behind the spermathecal plate.

Each of the paraspermathecal plates, which parallel and partially underly the spermathecal plate, is composed of two distinct regions. The inner, more longitudinal foot-like portion has a basal "toe" area extending cephalad, a mesally produced median area bearing a triangular, tooth-like process directed mesad, and a distal tapering region which, along its inner surface, slightly underlies the outer edge of the spermathecal plate. The more distal parts of the inner margins of these areas diverge laterad to form the "heel" of the "foot." The anterior margin of the median area usually is directed somewhat laterad, so that the bluntly rounded "toe" points a little to the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side. The lateral margin then recurves mesad and swings out again to form the base line of the outer produced area of the plate. The middle portion of the inner part (i.e., the "foot") usually is produced downward in a rounded hump from which the tooth arises. The tooth is broad at the base and may be blunt to slightly pointed apically. Caudad of the tooth the margin of the inner region forms a broadly triangular point (Fig. 8). The inner face of this triangle is rolled over into a rounded surface which lies somewhat beneath the outer edges of the spermathecal plate.

The second area of the paraspermathecal plate is a flattened, spatulate lobe which reaches caudad to the anterior margin of the arm of the ventral valvula. When the various parts are in a closed position, the posterior edge of the produced region of the paraspermathecal plates fits below the valvular arm and rests within the angle formed by the dorsal fold on the valve-arm base. The margin may be slightly emarginate or smoothly rounded. The

EXPLANATION OF PLATE

FIG. 1. *Eurycotis floridana*, ventral view of female subgenital plates.
FIG. 2. *Periplaneta americana*, same.
FIG. 3. *E. floridana*, female, side view of end of abdomen.
FIG. 4. *Blatta orientalis*, same.
FIG. 5. *E. floridana*, ventral view of ovipositor and related structures.
FIG. 6. *E. floridana*, dorsal view of genital plate and folded-in 7th sternal membrane.
FIG. 7. *P. americana*, spermathecal and paraspermathecal plates, caudo-ventral view.
FIG. 8. *E. floridana*, same.
FIG. 9. *E. floridana*, 1st valvula and 9th apodeme.
FIG. 10. *P. americana*, same.
FIG. 11. *E. floridana*, genital plate, dorsal view.
FIG. 12. *P. americana*, same.
FIG. 13. *E. floridana*, caudal view of dissected spermatheca and associated plates (accessory gland not complete).

LIST OF ABBREVIATIONS USED

| | |
|---|---|
| VI, VII, etc. | = tergal plates |
| 6, 7 | = sternal plates |
| Cer | = cercus |
| Ppt | = paraproct |
| 7L | = lobes of 7th sternum |
| 7B | = base of 7th sternum |
| SpP | = spermathecal plate |
| PspP | = paraspermathecal plate |
| 1 vlv, 2 vlv, 3 vlv | = valvulae of ovipositor |
| 1 vlf, 2 vlf | = valvifers of ovipositor |
| Fo | = folds of 7th sternal membrane |
| 7Ssc | = 7th sternal sclerites |
| r | = roof of space into which tip of ovipositor fits |
| sp | = space into which ovipositor tip fits |
| SePl | = setose plate |
| Gp | = gonopore |
| GpPl | = gonopore plate |
| Sp | = spermatheca |
| ap | = apodeme |
| 9Stp | = 9th sternal plates |

dorsal surface usually bears a shallow basal longitudinal impression. Mesally it is usually separated from the inner portion of the plate by a faint but distinct longitudinal ridge. Both upper and lower surfaces of the apical area are moderately supplied with short setae or spines. These are continuous ventro-mesally with those on the apex of the inner triangular area.

The cephalic extremities of the sclerotic extensions of paraspermathecal plates and the genital plate are separated by a narrow strip of flexible membranous tissue. Mesally, these narrow bands are continuous with non-sclerotic median areas lying anterior to both the gonopore below and the spermathecal papilla above. Laterally, the separating strips merge with widely expanded membranous areas. These, with numerous folds incorporated, are continuous dorso-laterally with the edges of the paraspermathecal plates and ventrally with the outer margins of the gonopore plates. Since the genital plate (8th sternum) is sloped backward beneath the spermatheca and the base of the ovipositor, the membranous flexible sidewalls form the sides of a slightly expandible reproductive pocket. Expansion (as ova are delivered) occurs as dorso-ventral displacement in the posterior part of the pocket. The two plates hinge anteriorly at the fold as described above; the gonopore opening is centered directly beneath the spermathecal papilla.

## INDIVIDUAL VARIATION

Certain of the structural features described above are found to vary considerably when a large segment of the colony's population is examined. The most commonly occurring variation is found in the projections of the second valvifers, as mentioned previously. The dorsal fold-ridge arising on the upper cephalic edge of the first valvular arm usually is missing when the valvifer knob of the same side is gone; it is nearly always present on the side where this projection occurs more consistently. Intermediate stages of development of the fold may be observed; these usually are accompanied by corresponding development of the second valvifer.

The paraspermathecal plates also are variable. These differences occur most noticeably on the same side as do the variation in the other parts. The entire sclerite sometimes is flattened; the mesal tooth lying beneath the spermathecal plate may be blunted, reduced, or sometimes missing on one side. The flattened ridge along the lower disto-lateral edge of the plate may likewise be modified.

The gonopore plates show only slight variation. The most common differences occur in the degree of sclerotization of the plates that parallel the genital slit.

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# NOTES ON THE MOSQUITOES (CULICINAE) OF THE CRETE (NEBRASKA) REGION[1]

WILLIAM F. RAPP, JR.[2]

The only extensive report on the mosquitoes of Nebraska is a paper by Tate and Gates (1944). This work reported thirty-three species for the state, and discussed them in a general way, giving no details on the mosquitoes of specific regions.

During June, July, and August 1952, a New Jersey Mosquito Light trap was operated at Crete, Saline County, Nebraska. During June and July the trap was operated at 1219 Ivy Street in the residential part of the city. In August the trap moved to the Vlasak-Cawley Concrete Plant on the western edge of the city near the Big Blue River. In this three month period the trap was operated a total of thirty-three nights.

Crete is located in the northeast corner of Saline County, in the Big Blue Valley. This area is in the North American Grassland Biome (*Stipa-Antilocapra* Biotic Formation). Actually, the Crete region is an ecotone between the true prairie (tall grass prairie) and the proclimax deciduous river bottom forest found along the Big Blue River. This ecological area is an important contact region where the deciduous forest, as a proclimax extends westward in the river valleys of the true prairie. The mosquitoes found in this region are a mixture of deciduous forest species and grassland species.

A total of 16 species were taken, with a total of 718 individuals. Table 1 shows the species taken at Crete.

### ANOPHELES

*Anopheles barberi* Coquillett

This tree hole breeder is a deciduous forest species possibly reaching its western limit in the proclimax river bottom forest of eastern Nebraska.

*Anopheles punctipennis* (Say)

This species has two broods as adults were taken on June 22, 24, 26, and 30, and again on August 12 and 14.

### AEDES

*Aedes dorsalis* (Meigen)

Tate and Gates (1944:15) found this species fifth in abundance in their state-wide survey. The large numbers occurring in the irrigated regions of western Nebraska. Only one male was taken in our traps. Experimental work has indicated that *A. dorsalis* is capable of transmitting western equine encephalomyelitis.

*Aedes nigromaculis* (Ludlow)

This species represented one per cent of the total number of species taken. Tate and Gates ranked this form as fourth in abundance. *A. nigromaculis* is considered to be a species favoring arid regions of the great plains. Under ex-

[1] The author wishes to thank Mr. L. D. Beadle and Dr. L. R. Edmunds of the U. S. Public Health Service for help in determining the material.

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TABLE I. Mosquitoes Taken by Light Trap at Crete, Nebraska, 1952

| Species | Total Male | Total Female | Total | Per Cent |
|---|---|---|---|---|
| Genus *Anopheles* | | | | |
| *barberi* | 0 | 1 | 1 | ....* |
| *punctipennis* | 0 | 7 | 7 | .... |
| Genus *Aedes* | | | | |
| *dorsalis* | 1 | 0 | 1 | .... |
| *nigromaculis* | 0 | 8 | 8 | 1 |
| *triseriatus* | 1 | 2 | 3 | .... |
| *trivittatus* | 13 | 75 | 88 | 12 |
| *vexans* | 98 | 171 | 269 | 37 |
| Genus *Culex* | | | | |
| *pipiens* | 20 | 80 | 100 | 14 |
| *restuans* | 26 | 42 | 68 | 9 |
| *salinarius* | 2 | 11 | 13 | 1 |
| *tarsalis* | 28 | 101 | 129 | 18 |
| *territans* | 0 | 1 | 1 | .... |
| Genus *Psorophora* | | | | |
| *ciliata* | 5 | 12 | 17 | 2 |
| *discolor* | 1 | 2 | 3 | .... |
| *signipennis* | 3 | 6 | 9 | 1 |
| Genus *Orthopodomyia* | | | | |
| *signifera* | 1 | 0 | 1 | .... |
| | 199 | 519 | 718 | |

*Less than one per cent

perimental conditions this species has transmitted the viruses of western equine encephalomyelitis and St. Louis encephalitis.

*Aedes triseriatus* (Say)

Three specimens of this tree hole breeder were taken. It is a species of minor importance in Nebraska.

*Aedes trivittatus* (Coquillett)

This widely distributed species represented 12 per cent of the number of species taken. *A. trivittatus* was taken during late July and early August.

*Aedes vexans* (Meiger)

This is the most abundant species in the Crete region. There are apparently several broods per year as specimens were taken throughout the entire trapping period.

*Culex pipiens* Linnaeus

This species was taken throughout the entire trapping season. This species is of both medical and veterinary importance, as it is a proven vector of western equine and St. Louis encephalitis and also heartworm of dogs. It is the third most abundant species in the Crete region.

*Culex restuans* Theobald

This species is common in the Crete region throughout the entire mosquito breeding season.

*Culex salinarius* Coquillett

This is an eastern form which apparently reaches its western limit in Nebraska. Although it is of minor importance in the Crete region, it is fairly abundant in other areas of eastern Nebraska.

*Culex tarsalis* Coquillett

This species, which reaches its largest populations in the semi-arid regions, is the second most abundant species in the Crete region. This species is the principal vector of western equine encephalitis.

*Culex territans* (Walker)

Only one specimen of this species was taken. Since the adults do not attack man, it is of little importance.

*Psorophora ciliata* (Fabricius)

This species reaches its western limit in Nebraska. It is of minor importance in the Crete region.

*Psorophora discolor* (Coquillett)

This species is very rare in Nebraska where it reaches its western limit.

*Psorophora signipennis* (Coquillett)

Tate and Gates (1944:23) found this species to be of major importance in Nebraska, but in the Crete region it is of minor importance.

## SUMMARY

A total of 16 species were collected at Crete, Nebraska, in the summer of 1952. The four most important species were. *Aedes vexans, Culex tarsalis, Culex pipiens,* and *Aedes trivittatus.* These four species made up 81 per cent of the summer's catch.

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# A NEW SPECIES OF *TORYMUS* (HYMENOPTERA: TORYMIDAE) PARASITIC ON *PACHYPSYLLA CELTIDIS-VESICULA* RILEY (CHERMIDAE) WITH NOTES ON ITS BIOLOGY AND OTHER PARASITOIDS ATTACKING THE SAME HOST AT COLUMBUS, OHIO

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The genus *Torymus* is a group in which the vast majority of species are ectoparasitic on dipterous or hymenopterous gall makers. Three species, however, have been recorded from Homoptera, one on the eggs of Cicadidae and two others as gall parasitoids of the genus *Pachypsylla* which are gall makers on *Celtis* sp. (hackberry). *Torymus pachypsyllae* (Ashmead)

is recorded, Ashmead (1888), from twig galls of *Pachypsylla venusta* (Osten Sacken). An additional host record is supplied by Lienk (1951), who records it from the leaf galls of *Pachypsylla celtidis-mamma* (Riley) the hackberry nipple gall maker. Another species, *Torymus scalaris* (Huber), is recorded from twig galls, Huber (1927), of *Pachypsylla celtidis-gemma* Riley.

In September 1950, several specimens of *Torymus* were reared from leaf galls of *Pachypsylla celtidis-vesicula* Riley (pl. II), the hackberry blister gall maker. They were identified by Mr. A. B. Gahan as a new species, which is described below. Dr. B. D. Burks identified the rest of the Chalcids listed in this paper.

*Torymus vesiculi* n. sp.

*Female:* Head metallic green, as wide as long, frontal aspect almost oval in outline; frons finely shagreened, and clothed with short, narrow, suberect, white hairs, these more abundant below attachment of antennae; bases of antennae separated by a prominent carina extending halfway to mouth; greatest diameter of lateral ocellus equal to two-thirds the ocellocular distance; scape yellow, as long as intermalar distance; pedicel and ring joint brown, funicular segments brown, closely set with short, dark brown hairs, first segment shorter than last but all longer than wide, the first segment shorter than pedicel, club slightly wider than funicle, longer than last two segments of funicle combined. Thorax elongate, metallic green with cupreous reflections; dorsum finely punctuate and clothed with moderately long, feebly appressed white hairs; parapsidal grooves deep; scutellum longer than wide, cross furrow absent; propodeum cupreous to green, with a distinct longitudinal median carina, strongly arched from scutellum; area laterad of spiracle rugose and clothed with long, erect, white hairs. Abdomen strongly compressed and short, as long as thorax in average dried condition, tergites finely reticulate; posterior margins of second and third tergites each with a deep longitudinal median incision, fourth with a shallow median incision; abdomen sparsely covered with setae, third tergite with one row of setae; sheath of ovipositor three-fourths as long as the abdomen and thorax combined. Legs yellow except base of middle and hind coxae which is concolorous with thorax; hind tibia blackish; tarsi whitish.

*Male:* (Fig. 3.) Head metallic green to cupreous, slightly wider than long; ocelli larger than in female; scape light brown and shorter than intermalar distance. Thorax less arched than in female.

*Measurements:* Female: Length of dried specimen 1.30 to 2.10 mm. (Holotype 2.10 mm.). Ovipositor sheaths 0.8 to 1.30 mm. (Holotype 1.30 mm.). Male: Length 1.3 to 1.9 mm. (Allotype 1.3 mm.).

Specimens of this species are frequently distorted by drying.

*Material examined:* All material from Columbus, Ohio collected on *Celtis occidentalis* L., the majority of females ovipositing in host galls. Female holotype (9-15-53) and male allotype (8-7-54) deposited in U. S. National Museum. Twenty-two female and 13 male paratypes deposited in the following institutions: British museum one female, one male (9-15-53); U. S. National Museum five females, five males (9-15-53); Cornell University

three females, four males (8-7-54); Ohio State University seven females, two males (9-15-53); Kansas State College six females, one male (9-15-53).

*Discussion:* This species is closely related to *Torymus pachypsyllae,* but B. D. Burks (personal communication) says that it is closer to *T. capite* (Huber), which I have not examined. *T. vesiculi* differs from *T. pachypsyllae* as follows: Smaller. Head more transverse; ocellocular distance and lateral ocellar line greater (figs. 5 and 6); the first segment of the funicle of female nearly as long as the last whereas in *T. pachypsyllae* the first segment is longer than the last (figs. 2 and 4). Abdomen strongly compressed and short; tergal hairs fewer in number and fewer in rows. Hind tibia blackish. Only minor differences were found in the ovipositors (figs. 7 and 8) and male genitalia. *T. pachypsyllae* distorted little upon drying.

*Torymus vesiculi* is a primary external parasitoid of the fourth and fifth instars of *Pachypsylla celtidis-vesicula,* the attack beginning in midsummer. The galls were checked weekly in 1954 from early spring to September 9 and the first specimens were observed August 7. They occurred in one locality in a characteristic swarm of about 100 individuals around the leaves and were composed mostly of males. One female was definitely observed ovipositing on August 7. By August 14 the wasps were generally distributed throughout the half-mile stretch of hackberry along the bank of the Olentangy River at the Ohio State University directly south of the new hospital where most of the observations have been made. Only three females were collected August 28 and observations on September 2 revealed that not one wasp was to be seen although the conditions were apparently optimum. However, by September 9 the wasp was found to be present in great numbers again and upon examination the galls revealed only eggs of the parasite. The wasp has been observed in previous years to be active and laying eggs until the leaves fall in October. My observations indicate that there are apparently three generations, the third overwintering. Only fifth instar larvae are to be found in the overwintering galls in the spring. This fact, as substantiated by Smith (1953), provides a means of control for *P. celtidis-vesicula* which often becomes a pest. The fact that the Chermids emerge in the fall and overwinter as adults whereas their parasites overwinter as larvae or pupae in the galls makes it a poor practice to rake and burn the leaves of this tree because this destroys the parasitoids.

*T. vesiculi* can be reared indoors from the leaves, and if not subjected to cold, it will emerge about January 1. The chances of it emerging are much better if it is left inside the gall, a small hole being carefully made in the gall to facilitate emergence. The wasp cannot emerge from the dry galls because they become too hard for the wasp to cut with its mandibles.

After the leaves have fallen a parasitized gall can be recognized by the fact that there is no hole in it where the Chermid has emerged. The larva is similar to that described by Hobbs (1950) for *T. festivis* Hobbs. Varley (1937) gives a similar description for the larva of *T. cyanimus* Boh. The average oviposition time, which has been observed in several specimens, varies from 30 to 45 minutes. The egg is laid next to the nymph, which is stung and immobilized as described by Beard (1952). The oviposition time seems long compared to that of a species of *Eupelmus,* which was observed

to accomplish the same process in nine minutes on the same species of gall.

As many as 100 Chermid galls may occur on a leaf and from 0 to 100 per cent may be parasitized, usually about 50 per cent. All of this parasitism is not due to *T. vesiculi*. Another Chalcidid, *Eupelmus* sp., has been observed ovipositing a few times in September and the third instar is attacked by two undescribed species of Eulophidae, one presumably of the genus *Chrysocharoideus* Girault and the other which may be a new genus of the subfamily Tetrastichinae near *Quadrastichodella* Gir., B. D. Burks (personal communication). Both forms are very abundant only during the month of July, fading out just before *Torymus* appears. Still another Chalcidid, *Psyllophagus pachypsyllae* (How.) (Encyrtidae), which is the only parasitoid found to be internal, has been found in the galls. This Encyrtid is not generally common and occurs in small populations which are sporadically distributed. However, of the parasitoids of *P. celtidis-vesicula*, this species is the only Chalcidid found which will attack other species of the genus *Pachypsylla*, all of the other Chalcidid parasitoids being apparently host specific. All members of the genus *Pachypsylla* in Ohio have been recorded as being parasitized by *Psyllophagus pachypsyllae* except *Pachypsylla intereris* Mally, Smith (1953) and Moser (1954), and I found numerous specimens of this parasitoid overwintering in the galls of this Chermid at Put-in-Bay (Gibralter Is.) Ohio on May 17, 1954. *Psyllophagus pachypsyllae* is the only parasitoid of *P. celtidis-vesicula* to overwinter in the pupal stage within the remains of its host. I have collected only the pupal stage of this parasitoid, and examination of the nymphal skins of the host in which the parasite pupae are enclosed reveals that it is probably the third stage that is attacked.

A sixth parasitoid found in the galls of *P. celtidis-vesicula* is a member of the family Cecidomyidae (Diptera). It was found feeding upon a third instar nymph on July 17, 1954. In previous years this larva had been found in unopened galls but its definite relationship had not been established. It is yellow in color and overwinters as a last stage larva. It is not common. This parasitoid may have an even wider host range than *Psyllophagus pachypsyllae*. I have found similar yellow larvae which I assume are parasitoids, in the galls of several of the hackberry Cecidomyid gall makers which have white larvae. Lal (1934) records an interesting account of a Cecidomyiid *(Endopsylla)* as a parasitoid of a Chermid *(Psylla pyricola)* in Scotland.

*Predators: Formica fusca* was observed carrying away the adults of *P. celtidis-vesicula* on September 20, 1953, and the two-spotted lady beetle also has been observed to eat the adult.

Few observations have been made on *Torymus pachypsyllae* but it apparently undergoes much the same type of life cycle on *Pachypsylla celtidis-mamma* as does *T. vesiculi* on *P. celtidis-vesicula*. *Pachypsylla celtidis-mamma* is the species most closely related to *Pachypsylla celtidis-vesicula* and the latter is about 100 times more abundant and its parasitoid, *Torymus vesiculi*, is about 100 times more abundant than *Torymus pachypsyllae*, the parasitoid of *Pachypsylla celtidis-mamma*. *Torymus pachypsyllae* is apparently the only parasitoid of *Pachypsylla celtidis-mamma* in Ohio. There is

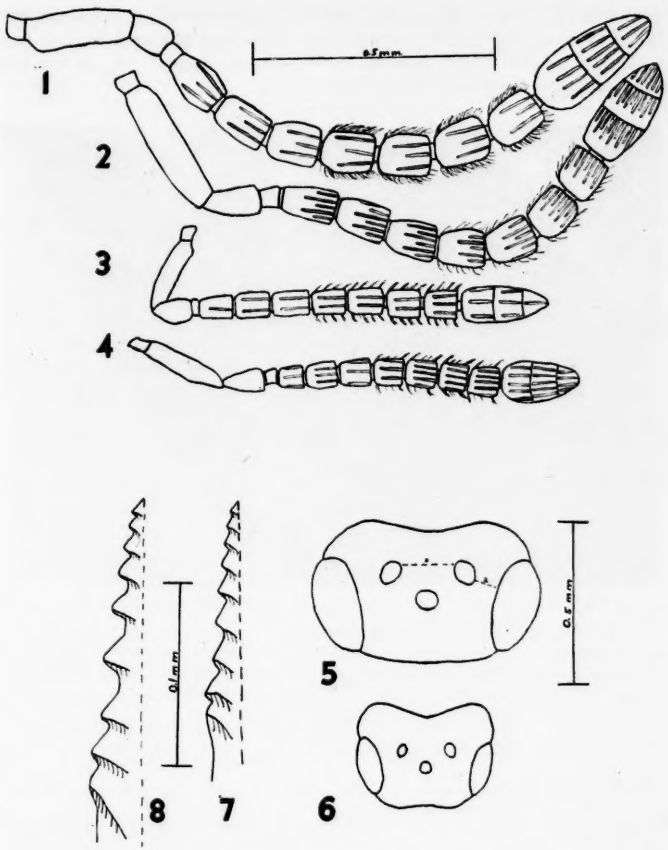


PLATE I

1. Antenna, male, *Torymus pachypsyllae* (Ash.). Setal pattern shown only on last four segments of funicle.
2. Antenna, female, *T. pachypsyllae*.
3. Antenna, male, *Torymus vesiculi* n. sp.
4. Antenna, female, *T. vesiculi*.
5. Head, dorsal view, *T. pachypsyllae*.
   a. ocellocular distance.
   b. lateral ocellar line.
6. Head, dorsal view, *T. vesiculi*.
7. Ovipositor saw, lateral view, *T. vesiculi*.
8. Ovipositor saw, lateral view, *T. pachypsyllae*.

evidence from Texas showing that more parasitoids attack it in the southern United States. At Ithaca, N. Y. *Psyllophagus pachypsyllae* attacks it to some extent and a larva which appears to be *Chrysocharoideus* n. sp. has been found once overwintering in a gall.

PLATE II

Photo of portion of leaf of *Celtis occidentalis L.* with light coming through leaf showing galls of *Pachypsylla celtidis-vesicula.*

1. Black galls. Color due to dead leaf material. This color is typical of galls parasitized by any one of the parasitoids except those attacking the fifth instar.
2. Normal galls. *Pachypsylla celtidis-vesicula* may be inside.

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# MALLOPHAGA (CHEWING LICE) OCCURRING ON THE DOMESTIC CHICKEN

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## INTRODUCTION

More species of Mallophaga (Chewing Lice) may be found on the domestic chicken than any other known fowl. Some of these appear to be normal parasites since they are found on the wild chickens of Southeast Asia. The remainder appear to have been derived from other hosts and are now well established on the chicken.

The large number of species of lice, since some are closely related, has made identification difficult for those not primarily interested in the taxonomy of the group. Although considerable literature has been published on control, most of this literature does not reflect the presently accepted taxonomic status of the species discussed. Distribution and host records given in economic entomological papers are often unreliable, since accuracy of the identifications is seldom verified by taxonomic specialists in the group. Some species, which appear to be common in the United States, have heretofore been unreported.

The purpose of this paper is to summarize the information contained in numerous taxonomic studies, and to furnish a means of ready identification for all the presently known species. Illustrations of the known forms found in the United States and its outlying territories are presented. The male and female figures are drawn to the same scale, the scale being shown on the left side of the plate. The male genitalia illustrations are not drawn to scale. The presently accepted synonymy, with references, has been included for each species. Only the host and distribution records appearing in recognized taxonomic papers have been accepted. These and unpublished data from identifications made by the author comprise the data included in this paper.

In Africa, lice normally found on the wild guineafowl have in some cases adapted themselves to the domestic chicken. Those that have not been reported on the domestic chicken outside of that region have been omitted from this paper.

## ACKNOWLEDGMENTS

The author is greatly indebted to Dr. Theresa Clay, British Museum (Natural History); Mr. G. H. E. Hopkins, Zoological Museum, Tring; and Mr. C. F. W. Muesebeck, U. S. National Museum, for their assistance and suggestions.

## KEY TO THE SPECIES OF MALLOPHAGA OCCURRING ON THE DOMESTIC CHICKEN

1. Maxillary palpi present ..... 2
   Maxillary palpi wanting ..... 5

2. Forehead armed ventrally with a pair of prominent spinelike processes ..... 3
   Forehead without ventral spinelike processes....*Menopon gallinae* (L.)
3. Abdominal tergites III-VII each with two transverse rows of setae ..... 4
   Abdominal tergites III-VII each with one transverse row of setae .....*Menacanthus pallidulus* (N.)
4. More than 2 mm in length. Numerous short setae scattered on dorsum of meso-metathorax .....*Menacanthus stramineus* (N.)
   Less than 2 mm in length. Dorsum of meso-metathorax with a few short setae on the lateral margins .....*Menacanthus cornutus* (S.)
5. Head longer than wide ..... 8
   Head wider than long ..... 6
6. Two long setae on each side of the head in the post antennal region; remainder of the chaetotaxy of the head with only short setae .....*Goniocotes gallinae* (DeG.)
   More than two long setae on each side of the head in the post antennal region; additional long setae on the dorsum of the head ..... 7
7. Antennae similar in the two sexes. Three long setae on each temple .....*Goniodes gigas* (T.)
   Antennae sexually dimorphic. Two long setae on each temple .....*Goniodes dissimilis* D.
8. Terminal abdominal segment of male with a sternal process. Lateral margins of terminal abdominal segment of female each with a longitudinal row of setae .....*Oxylipeurus dentatus* (S.)
   Terminal abdominal segment of male without a sternal process. Lateral margins of terminal abdominal segment of female each without a longitudinal row of setae ..... 9
9. 1st antennal segment of male with an appendage. Dorsally, a patch of long setae in each posterior lateral angle of pterothorax; with the intervening margin void of long setae ..... 10
   1st antennal segment of male without an appendage. Dorsally, four patches of long setae on posterior margin of pterothorax .....*Cuclotogaster heterographus heterographus* (N.)
10. Posterior margin of vulva, in female, with a row of short setae. In the male, post-antennal constriction; greatest width of head in the preantennal region .....*Lipeurus caponis* (L.)
    Posterior margin of vulva, in female, without a row of short setae. In the male, greatest width of head in the post-antennal region .....*Lipeurus lawrensis tropicalis* P.

*Cuclotogaster heterographus heterographus* (Nitzsch)
(Plate I, figs. 1-3)

*Lipeurus heterographus* Nitzsch, 1866. In Giebel, Z. ges. NatWiss., 28: 381.
*Goniocotes burnetti* Packard, 1870. Amer. Nat., 4: 94, fig. 26.
*Lipeurus pallidus* Giebel, 1874. Insecta Epizoa: 219.
*Lipeurus heterographus* var. *major* Piaget, 1880. Les Pédiculines: 362 (*nec* 346).
*Goniodes eynsfordii* Theobald, 1896. Parasitic Diseases Poultry: 26, fig. 8.

*Cuclotogaster laticorpus* Carriker, 1936. Proc. Acad. Nat. Sci. Philad., 88: 67, pl. I, fig. 2.
*Gallipeurus heterographus heterographus* (Giebel), Clay, 1938. Proc. Zool. Soc. London, Ser. B, 108: 136, figs. 15-18a.
*Cuclotogaster heterographus* (Nitzsch), Hopkins and Clay, 1952. A check list of the genera and species of Mallophaga: 95.

This species is common on the domestic chicken and is world-wide in distribution. It has also been found on hatchery-reared ring-necked pheas-

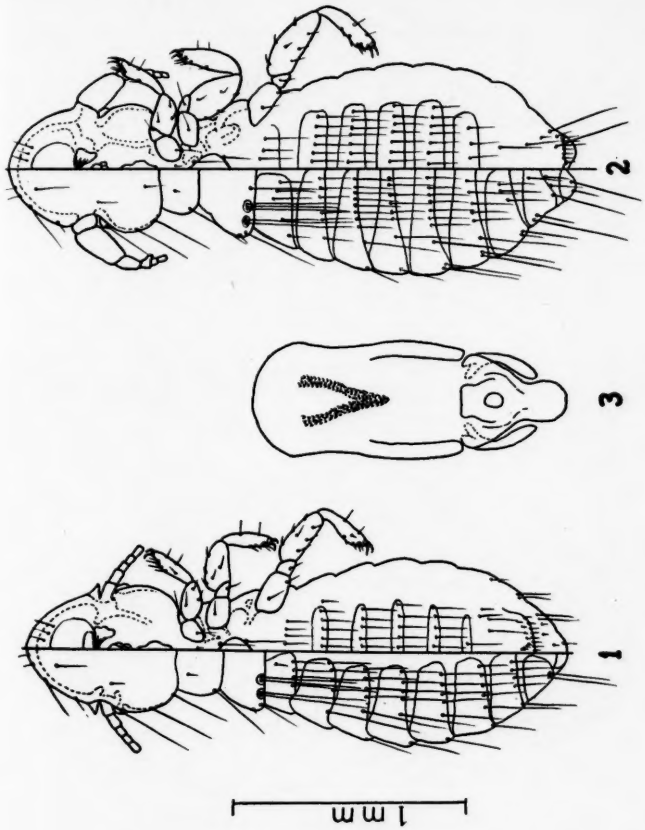


PLATE I

*Cuclotogaster heterographus heterographus* (Nitzsch).
FIG. 1. Dorsal-ventral view of female.
FIG. 2. Dorsal-ventral view of male.
FIG. 3. Male genitalia.

ants in New York, California and Canada. The three other subspecies of this complex are found on certain partridges found in Asia Minor and the Mediterranean Area. Since the species has not been found on any of the wild chickens, it probably was derived from one of the partridges of the genus *Alectoris* in Asia Minor or the Mediterranean Area. This parasite is presently known as the "chicken head louse."

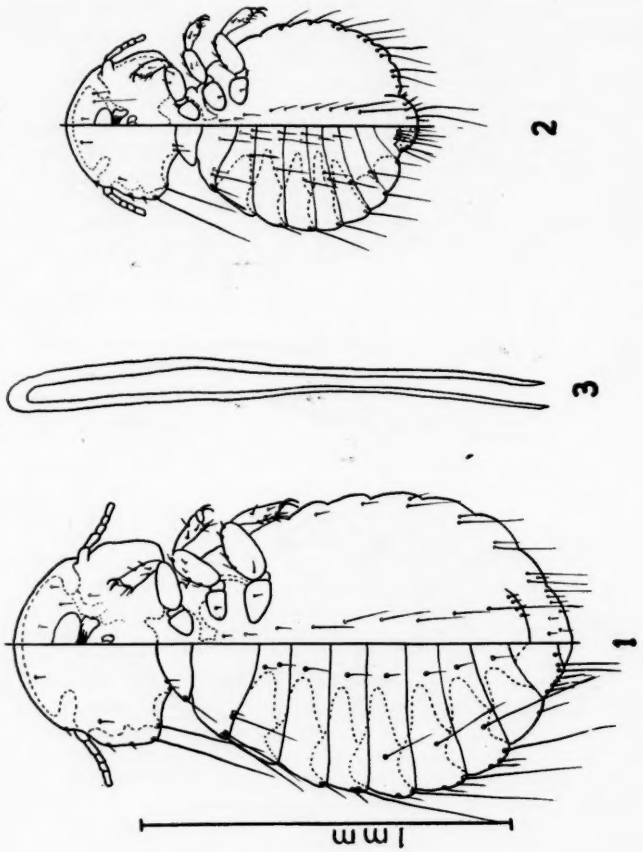


PLATE II

*Goniocotes gallinae* (DeGeer).

FIG. 1. Dorsal-ventral view of female.
FIG. 2. Dorsal-ventral view of male.
FIG. 3. Male genitalia.

*Goniocotes gallinae* (DeGeer)
(Plate II, figs. 1-3)

*Ricinus gallinae* DeGeer, 1778. Mém. Hist. Ins., 7: 79, pl. 4, fig. 15.
*Philopterus (Goniodes) hologaster* Nitzsch, 1818. Germar's Mag. Ent., 3: 294 (*Nomen novum* for *Ricinus gallinae* DeGeer).
*Goniocotes gallinae* (DeGeer), Hopkins and Clay, 1952. A check list of the genera and species of Mallophaga: 147.

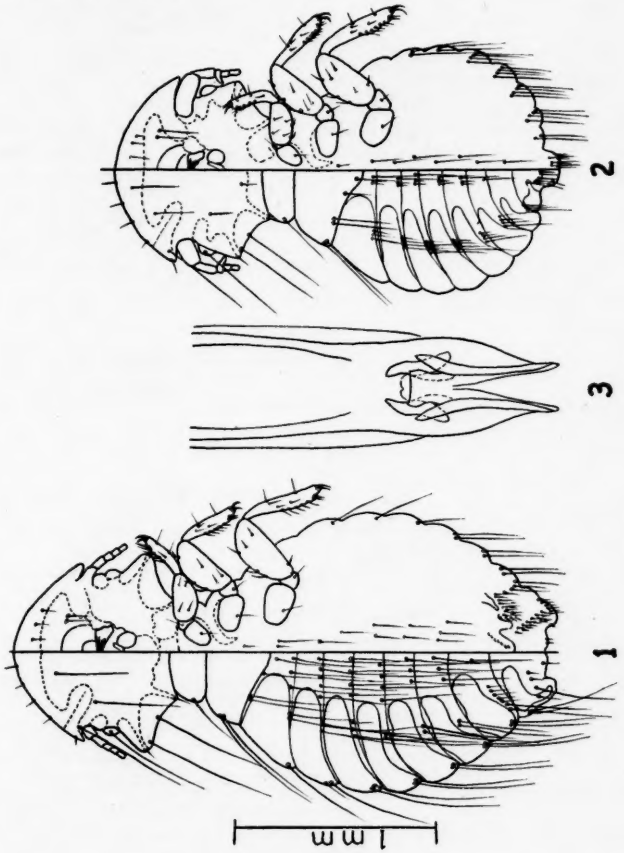


PLATE III
*Goniodes dissimilis* Denny
FIG. 1. Dorsal-ventral view of female.
FIG. 2. Dorsal-ventral view of male.
FIG. 3. Male genitalia.

This species is common on the domestic chicken and is world-wide in distribution. It is found on the wild chickens of Southeast Asia, thus indicating that the wild chicken is probably the original host. Specimens have been examined which were collected from various gallinaceous birds maintained in zoological gardens. These records have not been authenti-

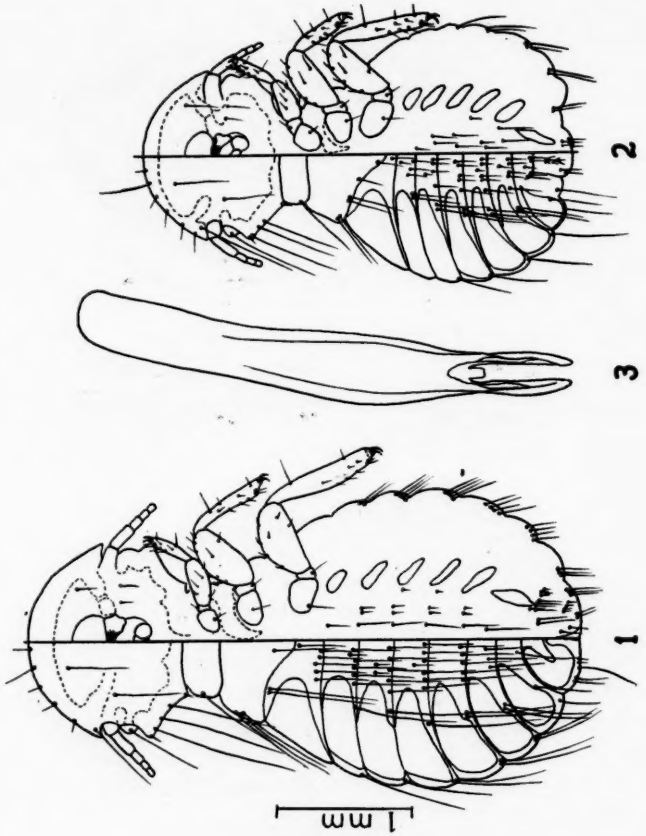


PLATE IV

*Gonides gigas* (Taschenberg)

FIG. 1. Dorsal-ventral view of female.

FIG. 2. Dorsal-ventral view of male.

FIG. 3. Male genitalia.

cated by collections from wild hosts, other than the chickens. This parasite is presently known as the "fluff louse."

### *Goniodes dissimilis* Denny

(Plate III, figs. 1-3)

*Goniodes dissimilis* Denny, 1842. Mon. Anopl. Brit.: 57 and 162, pl. 12, fig. 6.
*Goniodes dissimilis* var. *bankiva* Piaget, 1880. Les Pédiculines: 269, pl. 22, fig. 3a.
*Goniodes dissimilis* Denny, Hopkins and Clay, 1952. A check list of the genera and species of Mallophaga: 153.

This species is common on the domestic chicken and is found in limited numbers on the domestic guineafowl in the United States. Specimens have been examined from all species of wild chickens found in Southeast Asia, indicating that the true host is probably the wild chicken. The present distribution appears to be world-wide. This parasite is presently known as the "brown chicken louse."

### *Goniodes gigas* (Taschenberg)

(Plate IV, figs. 1-3)

*Goniocotes hologaster* Denny, 1842 (*nec* Nitzsch, 1818). Mon. Anopl. Brit.: 56 and 153, pl. 13, fig. 4.
*Goniocotes gigas* Taschenberg, 1879. Z. ges. NatWiss., 52: 104, pl. I, fig. 10 (*Nomen novum* for *Goniocotes hologaster* Denny).
*Goniocotes abominalis* Piaget, 1880. Les Pédiculines: 238, pl. 20, fig. 9.
*Goniodes gigas* (Taschenberg), Hopkins and Clay, 1952. A check list of the genera and species of Mallophaga: 154.

This species is common on the domestic chicken and domestic guineafowl. Specimens have been examined from several species of wild guineafowl, and this appears to be the original host since it has not been recorded from any other wild host. The species is known to be present on the domestic chicken in North America, Central America, Australia, Africa, and Europe. It probably has spread to other parts of the world where the guineafowl has been introduced. This parasite is presently known as "large chicken louse."

### *Lipeurus caponis* (Linnaeus)

(Plate V, figs. 1-3)

*Pediculus caponis* Linnaeus, 1758. Syst. Nat., 10th ed.: 614.
*Lipeurus variabilis* Burmeister, 1838. Handb. Ent., 2: 434.
*Nirmus tessellatus* Denny, 1842. Mon. Anopl. Brit.: 49 and 121, pl. 7, fig. 2.
*Lipeurus antennatus* Piaget, 1885 (*nec* Giebel, 1874). Les Pédiculines, Supplément: 75, pl. 8, fig. 3.
*Lipeurus variabilis* var. *alpha* Kellogg, 1908. In Wytsman's Gen. Ins., 66, Mallophaga: 45 (*Nomen novum* for *Lipeurus variabilis* var. α Piaget, 1880: 366).
*Lipeurus variabilis* var. *beta* Kellogg, 1908. *Ibid*:45 (*Nomen novum* for *Lipeurus variabilis* var. *B* Piaget, 1880: 366).
*Lipeurus variabilis* var. *gamma* Kellogg, 1908. *Ibid*: 45 (*Nomen novum for Lipeurus variabilis* var. *r* Piaget, 1880: 366).
*Lipeurus variabilis* var. *formosanus* Sugimoto, 1929 (*nec* Uchida, 1917). Rep. Dep. Agri. Res. Inst. Formosa, 43: 53.
*Lipeurus lineatus* McGregor, 1917 (*nec* Giebel, 1874). Psyche, 24: 114, pl. 7, figs. 2 and 5.
*Lipeurus dovei* McGregor, 1918. Psyche, 25: 46 (*Nomen novum* for *Lipeurus lineatus* McGregor).
*Lipeurus caponis* (Linneaus), Hopkins and Clay, 1952. A check list of the genera and species of Mallophaga: 192.

*Lipeurus dovei* McGregor, Hopkins and Clay, 1952. *Ibid:* 193.
*Lipeurus caponis borcherti* Eichler, 1953. Mh. Vet. Med., 8: 556, fig.

This species is common on the domestic chicken and is world-wide in distribution. It is found on the wild chickens of Southeast Asia, thus indicating that the wild chicken is probably the original host. Specimens have been examined which were collected from various gallinaceous birds main-

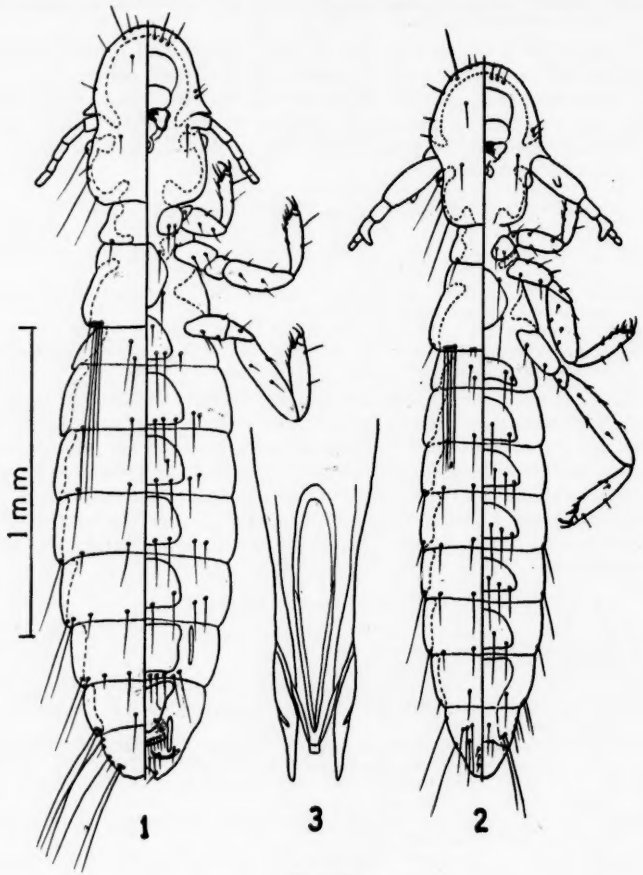


PLATE V

*Lipeurus caponis* (Linnaeus)

FIG. 1. Dorsal-ventral view of female.
FIG. 2. Dorsal-ventral view of male.
FIG. 3. Male genitalia.

tained in zoological gardens. This parasite is presently known as the "wing louse."

*Lipeurus lawrensis tropicalis* Peters

(Plate VI, figs. 1-3)

*Lipeurus tropicalis* Peters, 1931. Ent. News, 42: 195, figs. 1-2.

*Gallipeurus lawrensis tropicalis* (Peters), Clay, 1938. Proc. Zool. Soc. London, Ser. 8, 108: 156.

*Lipeurus tropicalis* Peters, Hopkins and Clay, 1952. A check list of genera and species of Mallophaga: 200.

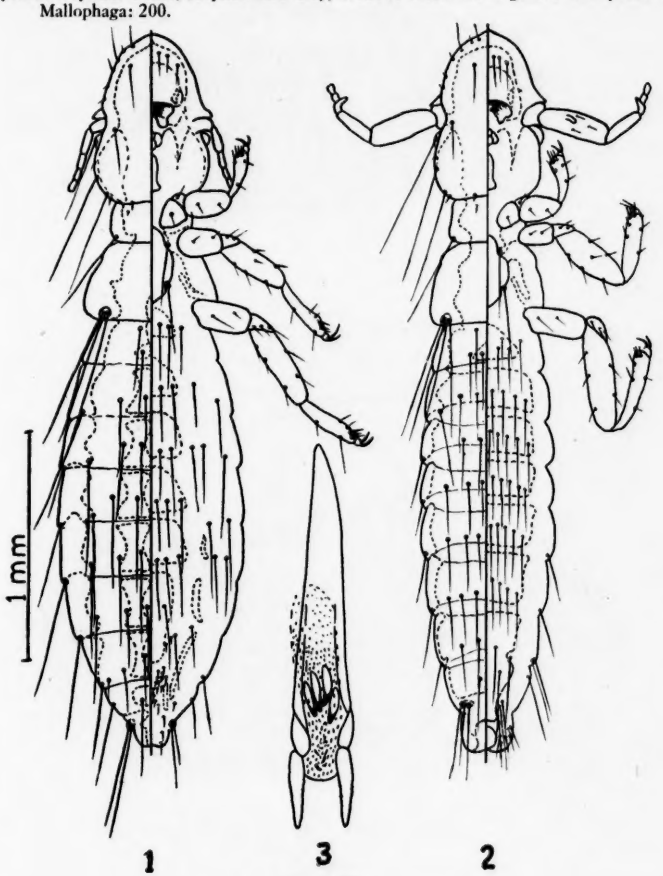


PLATE VI

*Lipeurus lawrensis tropicalis* (Peters)

FIG. 1. Dorsal-ventral view of female.

FIG. 2. Dorsal-ventral view of male.

FIG. 3. Male genitalia.

This species has been recorded from the domestic chicken in tropical or sub-tropical regions, and from five subspecies of wild guineafowls. The U. S. National Museum has material of this species collected from the domestic chicken in Brazil, Venezuela, Panama Canal Zone, British West Indies, Puerto Rico, Cuba, British East Africa, Liberia, Ethiopia and India.

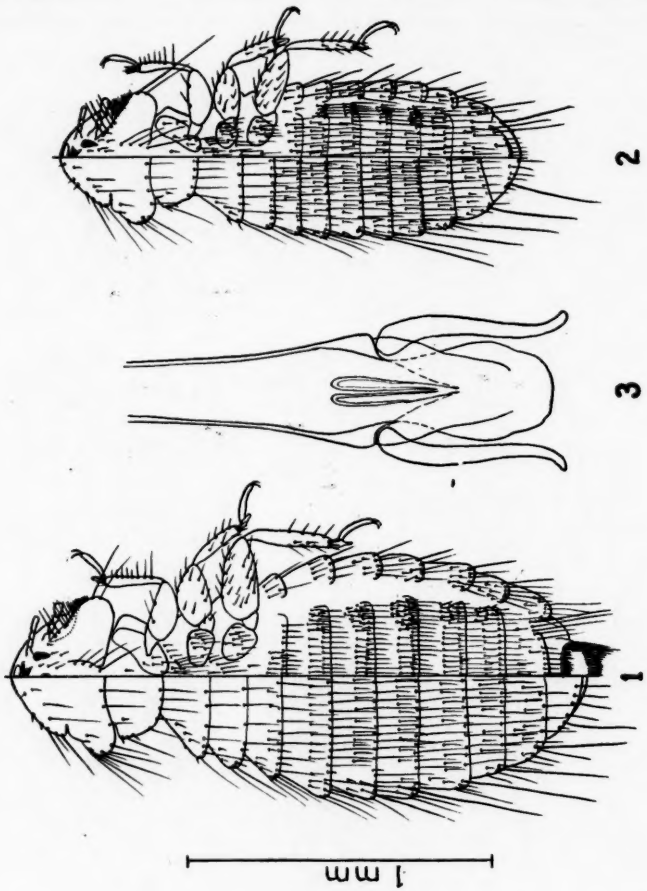


PLATE VII

*Menacanthus cornutus* (Schommer)
FIG. 1. Dorsal-ventral view of female.
FIG. 2. Dorsal-ventral view of male.
FIG. 3. Male genitalia.

To date, this species has not been recorded from the United States, but its presence in the Gulf Coast region is to be expected. *Lipeurus lawrensis lawrensis* Bedford, a closely related form, has also been recorded from wild guineafowls, thus indicating that *tropicalis* was derived from the wild guineafowl. Neither has been found on the wild chickens of Southeast Asia.

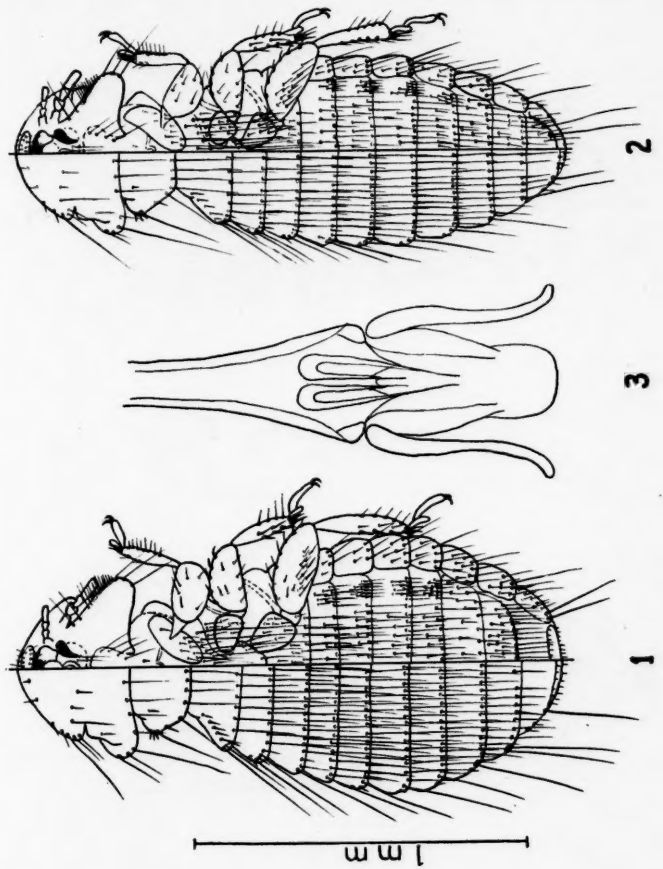


PLATE VIII

*Menacanthus pallidulus* (Neumann)

FIG. 1. Dorsal-ventral view of female.
FIG. 2. Dorsal-ventral view of male.
FIG. 3. Male genitalia.

## *Menacanthus cornutus* (Schömmer)

(Plate VII, figs. 1-3)

*Menopon cornutum* Schömmer, 1913. Über die Mallophagen, insbesondere die unserer Haustiere: 64 and 71, pl. 7, figs. 29a-e.

*Menacanthus cornutus* (Schömmer), Hopkins and Clay, 1952. A check list of the genera and species of Mallophaga: 208.

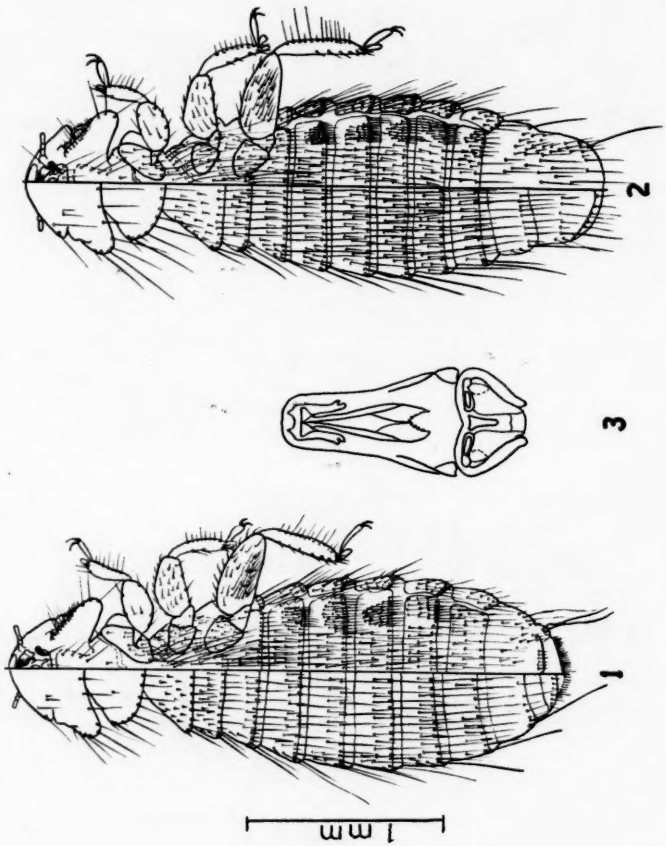


PLATE IX

*Menacanthus stramineus* (Nitzsch)

FIG. 1. Dorsal-ventral view of female.

FIG. 2. Dorsal-ventral view of male.

FIG. 3. Male genitalia.

This species has not been previously reported from the United States, but previous records of *Menacanthus pallidulus* (N.) probably have included this form since the two are very similar. The author has found it in abundance on farm flocks of chickens in Oklahoma, and the U. S. National Museum has material collected at Auburn, Alabama. While the species has

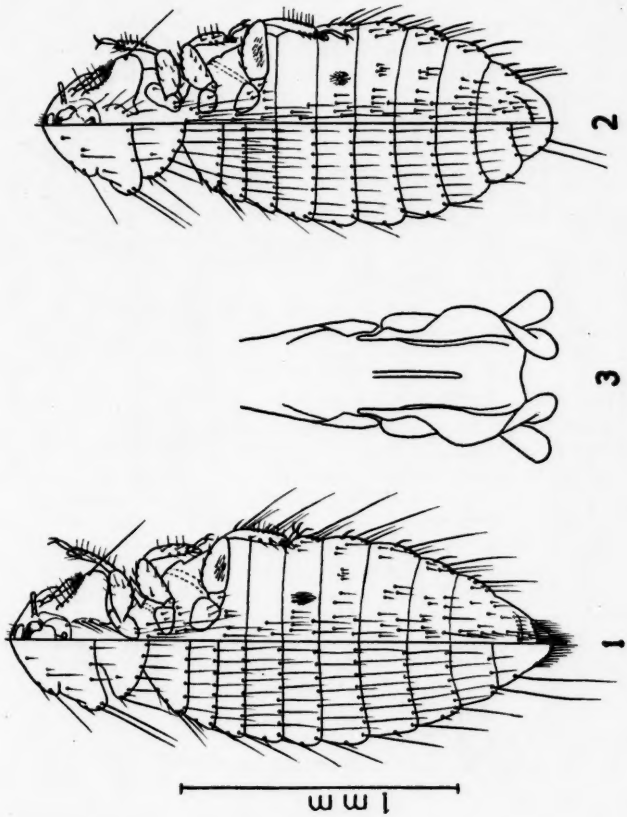


PLATE X

*Menopon gallinae* (Linnaeus)

FIG. 1. Dorsal-ventral view of female.

FIG. 2. Dorsal-ventral view of male.

FIG. 3. Male genitalia.

been collected from domestic chickens in many regions of the world, I have examined only one specimen collected from a wild chicken. Further collections will be necessary to determine its distribution in the United States, and to determine the original host.

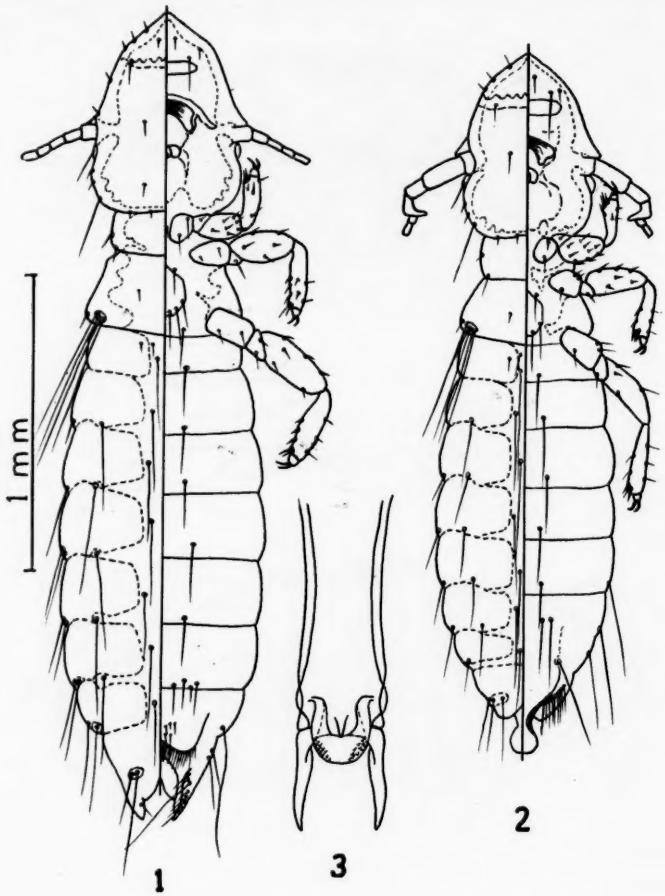


PLATE XI

*Oxylipeurus dentatus* (Sugimoto)

FIG. 1. Dorsal-ventral view of female.

FIG. 2. Dorsal-ventral view of male.

FIG. 3. Male genitalia.

### *Menacanthus pallidulus* (Neumann)
(Plate VIII, figs. 1-3)

*Menopon pallidulum* Neumann, 1912. Arch. Parasit., 15: 361, figs. 7-9.

*Menacanthus pallidulus* (Neumann), Hopkins and Clay, 1952. A check list of the genera and species of Mallophaga: 212.

This species is common on the domestic chicken and is world-wide in distribution. Previous records from the United States have been few because frequently the species has been misidentified as the immature form of *Menacanthus stramineus* (N.). Material in the U. S. National Museum shows that the species is common throughout the United States. It has been collected from the wild chickens of Southeast Asia, thus indicating that the original host was the wild chicken.

### *Menacanthus stramineus* (Nitzsch)
(Plate IX figs. 1-3)

*Pediculus meleagridis* Panzer, 1793 (*nec* Linnaeus, 1758). Faun. Ins. Germ.: 51, fig. 20.

*Liotheum (Menopon) stramineum* Nitzsch, 1818. Germar's Mag. Ent., 3: 300 (*Nomen novum* for *Pediculus meleagridis* Panzer).

*Menopon biseriatum* Piaget, 1880. Les Pédiculines: 460, pl. 37, fig. 2.

*Zemiodes zumpti* Eichler, 1944. Z. hyg. Zool., 35: 172, fig.

*Menacanthus stramineus* (Nitzsch), Hopkins and Clay, 1952. A check list of the genera and species of Mallophaga: 125.

*Zemiodes zumpti* Eichler, Hopkins and Clay, 1952. *Ibid:* 362.

This species is common on the domestic chicken and turkey. Domestic guineafowls, peafowls, quails and pheasants hatched under chickens or maintained in zoological gardens are usually infested. Occasionally individuals may be found on domestic ducks and geese. It is very unlikely that breeding populations have become established on the non-gallinaceous hosts, but probable that the few individuals encountered are stragglers from close association in the barnyard with chickens and turkeys. Specimens have been examined from several subspecies of wild turkeys collected in the United States and Mexico. The species has not been found on other wild hosts, thus indicating that the original host was probably the wild turkey. The species is common in Canada, United States, Mexico, Australia, Europe, Turkey, and South and East Africa. It is probably found in all regions into which the turkey has been introduced. This parasite is presently known as the "chicken body louse."

### *Menopon gallinae* (Linnaeus)
(Plate X, figs. 1-3)

*Pediculus gallinae* Linnaeus, 1758. Syst. Nat., 10th ed.: 613.

*Nirmus trigonocephalus* Olfers, 1816. De Veg. et Anim. Corp. in Corp. Anim. Ref. Comm.: 90.

*Liotheum (Menopon) pallidum* Nitzsch, 1818. Germar Mag. Ent., 3: 299 (*Nomen novum* for "*Pulex capri* Redi" and "*Pediculus gallinae* Panzer").

*Menopon productum* Piaget, 1880. Les Pédiculines: 461, pl. 37, fig. 8.

*Menopon productum* var. *major* Piaget, 1880. *Ibid:* 462 (*nec* 441).

*Menopon subaequale* var. *producta* Piaget, 1885. Les Pédiculines, Supplément: 109.

*Menopon brevipes* Piaget, 1885. *Ibid:* 110, pl. 12, fig. 1.

*Menopon longicephalum* Kellogg, 1896. Proc. Calif. Acad. Sci., (2) 6: 535, pl. 73, fig. 4.

*Menopon lunalale* Eichler, 1947. Arkiv för Zoologi, 39a (2): 17, fig. 35-38.

*Menopon gallinae* (Linnaeus), Hopkins and Clay, 1952. A check list of the genera and species of Mallophaga: 219.

*Menopon brevipes* Piaget, Hopkins and Clay, 1952. *Ibid:* 217.

*Menopon lunalale* Eichler, Hopkins and Clay, 1952, *Ibid:* 220.

*Menopon major* Piaget (p. 462, *nec* 441), Hopkins and Clay, 1952. *Ibid:* 220.

*Menopon productum* Piaget, Hopkins and Clay, 1952. *Ibid:* 222.

*Menopon productum* Piaget (*nec* 1880), Hopkins and Clay, 1952. *Ibid:* 222.

*Menopon gallinae* (Linnaeus), Emerson, 1954. Ann. Mag. Nat. Hist. (2) 7: 225, fig. 8.

This species is common on the domestic chicken and is world-wide in distribution. Collections from the domestic guineafowl are common. It has been found on all but one species of the wild chickens of Southeast Asia, thus indicating that the wild chicken is probably the original host. Specimens have been examined which were collected from various gallinaceous birds maintained in zoological gardens; however, the guineafowl appears to be the only other domestic bird on which the form is found. This parasite is presently known as the "shaft louse."

### *Oxylipeurus dentatus* (Sugimoto)
(Plate XI, figs 1-3)

*Lipeurus dentatus* Sugimoto, 1934. Taiwan no Chikuzan, 2: 2 (of reprint, original not seen), figs. 1-12.

*Lipeurus denticlypeus* Sugimoto, 1935. Zoological Record. 72, Insecta: 419 (Quotation of name altered by Sugimoto in reprint).

*Lipeurus angularis* Peters, 1935. Ohio J. Sci., 35: 102, figs. 1-3.

*Oxylipeurus dentatus* (Sugimoto), Hopkins and Clay, 1952. A check list of the genera and species of Mallophaga: 257.

The abundance and distribution of this species is not well known. It has been collected from several of the wild chickens of Southeast Asia, indicating that the true host is probably the chicken. The few collection records in the U. S. National Museum from the domestic chicken are: Nicaragua, Panama Canal Zone, and the various islands of the Central Pacific Area. To date, this species has not been recorded from the United States, but its presence in the Gulf Coast region is to be expected.

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# EVIDENCE OF INTERGRADATION BETWEEN PUTATIVE SPECIES OF COLYMBETES IN SOUTH DAKOTA (Coleoptera: Dytiscidae)[1]

F. N. YOUNG AND H. C. SEVERIN

The North American forms of *Colymbetes (s. str.)* show such a wide range of individual variation and such marked tendencies to form local geographical races that the taxonomy of the group is in a somewhat confused state. In the Eastern United States *Colymbetes sculptilis* (Harris),

[1] Contribution No. 600 from the Zoological Laboratories of Indiana University, and No. 341 from the Agricultural Experiment Station of South Dakota State College.

the only species of the genus found in the lowlands, is easily recognized by the subgeneric characters, but in the Great Plains states and Central Canada a form with more coarsely sculptured elytra and pronotum largely replaces or intermingles with typical *sculptilis*. The latter has usually been considered a distinct species (*C. rugipennis* Sharp) or a variety of *sculptilis* (Hatch 1928:225). Examination of large series of eastern specimens and this more roughly sculptured form indicates that the two intergrade in nearly all characters in South Dakota and elsewhere. It, therefore, seems desirable to recognize an eastern and a western geographical (allopatric) subspecies. The eastern form would thus be: *Colymbetes (s. str.) sculptilis sculptilis* (Harris); and the western, for reasons detailed below:

*Colymbetes (s. str.) scultipils exaratus* LeConte new combination

Dr. P. J. Darlington, Jr., has kindly compared a female specimen from South Dakota with LeConte's types of *exaratus* in the Museum of Comparative Zoology (Type No. 6081). He writes that he can find no significant differences between the specimens, and that the differences between *exaratus* and our specimens and the type of *sculptilis* (MCZ Type No. 812) seem to him to be not more than of subspecific importance.

Unfortunately, all of LeConte's specimens which can safely be considered cotypes of *exaratus* are females so that the male tarsal characters cannot be used to fix the identity of the name. Crotch (1873:405) states that *exaratus* is allied to *sculptilis,* from which it differs only in the more deeply sculptured pronotum and elytra. He does not mention the male tarsal characters, but he must have seen specimens other than LeConte's types since he gives the distribution as "Nebraska, Kansas, Dacotah, Hudson's Bay." Sharp (1882:623), on the other hand, places *exaratus* with *strigatus* LeConte on the basis of the male tarsal characters but gives the same distribution as Crotch. He then describes *rugipennis* (1882:628) from the "Northern boundary of Nebraska" as being similar to and having the same tarsal characters as *sculptilis* but differing in that the female has "the transverse grooves on the elytra . . . considerably deeper on the basal half while on the apical half they are hardly so deep or approximate. . . ."

Sharp's description of *exaratus* does not fit LeConte's types according to Dr. Darlington nor does it agree with any specimens we have yet seen from South Dakota, Minnesota, Wisconsin, Saskatchewan, Manitoba or localities to the east. It does fit specimens of *"exaratus"* from British Columbia sent us by H. B. Leech, so two recognizable entities evidently exist.

LeConte's types of *exaratus* are marked with green disks which designate "Nebraska and vicinity," but the disks are trimmed to a point on one side which probably indicates some specific locality. The original description (1862:522 gives the type locality as "Methy." Dr. Joseph St. Jean has kindly checked maps of Canada for us and only one locality (indicated on an 1880 map) seems probable. This is the Methy River and town of Methy, a Hudson Bay trading post, at 56½° N, 109¼° W. This checks fairly closely with information received from the Nebraska Historical Society locating a Lake Methye with a Fort Methye at its south end about 180 miles south of Lake Athabasca, and another Lake Methye about 350 miles

southwest. No locality in Kansas, Nebraska, nor the Dakotas seems now to bear the name "Methy," but an unfortunate joker is that the word is a Cree term designating a kind of fish and corruptly rendered "Marthy." Thus "Martha's Island" in the Missouri River and the nearby "Marty" in Charles Mix County, South Dakota, are suspect, although they are supposed to have been named after the first white woman to arrive in South Dakota.

In any event the locality from which LeConte's specimens of *exaratus* came is apparently either within or close to the area of the Great Plains, and all the evidence on distribution which we have been able to accumulate indicates that the roughly-sculptured form is characteristic of that region and is replaced in the mountains to the west by species of *Cymatopterus, strigatus*-like forms or forms apparently identical with the eastern *sculptilis*. Thus *rugipennis* Sharp should probably be synonymized with the *exaratus* of LeConte and Crotch and the form identified as *"exaratus"* by Sharp (1882), Hatch (1928, 1953) and others left for the present without a name.

A detailed examination of large series of *Colymbetes* from South Dakota, and scattered specimens from neighboring states and southern Canada, indicates that the less heavily sculptured *sculptilis* intergrades in all characters with the more coarsely sculptured *exaratus*. There is a rough east-west cline passing from typical *sculptilis* as found in Indiana and Michigan to typical *exaratus* (= *rugipennis)* west of the Missouri River. The variation is complex, however, and the total cline may involve a transition from *sculptilis,* through mixed *exaratus-sculptilis* populations back to apparently typical *sculptilis* again in Colorado and probably elsewhere in the Rockies.

The accompanying table summarizes the results of semi-quantitative rating of South Dakota specimens on the basis of pronotal and elytral sculpture. The counties listed are roughly arranged in north-south tiers, and it is evident that there is a general trend from populations with many intermediate and *sculptilis*-like members in the east to almost pure *exaratus* to the west. The series from Martin, in Bennett County, is the only notable exception and on considering other characters all of these specimens seem to be intermediate between *sculptilis* and *exaratus*. A count of the basal elytral rugae shows that there are about 37 to 2.7 mm. in Massachusetts *sculptilis* and 34 to 2.7 mm. in western South Dakota specimens with all degrees of intermediacy in specimens from localities between. A similar relation holds for the pronotal sculpture which varies from deeply reticulate-punctate sometimes rugose in western South Dakota to shallowly reticulate with many "cells" unclosed and the punctation less evident in the eastern states. Both of these extremes plus intermediates are found in South Dakota.

The male genitalia are identical even to many minor features such as the hook at the tip of the aedeagus and the spines along its shaft. The male tarsal characters are identical except that the 3rd and 4th segments of the foretarsi are usually more dilated in South Dakota specimens. Intermediates, however, were noted even west of the Missouri (discounting

the Bennett County series). The emargination of the last abdominal sternite seems somewhat deeper in South Dakota specimens, but this also varies greatly. Measurements of length and body proportions show no significant differences. The color pattern of head and thorax is reduced in western individuals, but all degrees of intermediacy are present in our series. East of the Missouri the degree of concordance of variation does not seem to be very high, that is, males with dilated tarsi may or may not show the rough pronotum and elytra, and more deeply emarginated last abdominal segment. West of the Missouri most specimens seem to be rather typically *exaratus,* with the striking exception of the Bennett County series.

Intergradation between these forms seems to occur over a wide area. Specimens from Saskatchewan and Manitoba received from J. B. Wallis show indications of being intermediate.

There may be a correlation between the degree of sculpturing and the type of habitat occupied. In Massachusetts *sculptilis* is taken most fre-

Variation in elytral and pronotal sculpture in *Colymbetes sculptilis* in South Dakota.

| County | exaratus | | Intermediates | | sculptilis | |
|---|---|---|---|---|---|---|
| | ♂ | ♀ | ♂ | ♀ | ♂ | ♀ |
| Roberts | 4 | 6 | | | | |
| Deuel | 1 | | | | | |
| Brookings | 48 | 109 | 19 | 5 | 8 | 3 |
| Marshall | 10 | 15 | 10 | | | |
| Day | 15 | 17 | 6 | | | |
| Clay | 1 | | | | | |
| Brown | 19 | 11 | 2 | | 1 | |
| Spink | | 1 | | | | |
| Beadle | 2 | 5 | 2 | 1 | | |
| Hutchinson | 1 | 1 | | | | |
| McPherson | 48 | 47 | 13 | | 2 | |
| Brule | 8 | 25 | 5 | | | |
| Aurora | | 3 | | | | |
| Walworth | 4 | | | | | |
| Lyman | 22 | 29 | 3 | | | |
| | 183 | 267 | 61 | 6 | 11 | 3 |
| Dewey | | | | | 1 | |
| Jones | | | 1 | | | |
| Mellette | 2 | 1 | | | | |
| Gregory | | 4 | 1 | | | |
| Corson | 8 | 8 | 1 | | | |
| Jackson | 3 | 8 | 2 | | | |
| Bennett | 1 | 3 | 29 | 21 | 5 | 11 |
| Perkins | | 1 | | | | |
| Meade | 3 | 1 | | | | |
| Butte | 1 | | 1 | | | |
| Pennington | | 5 | | | | |
| | 18 | 31 | 35 | 21 | 6 | 11 |

quently in the spring in swamps and marshes; in Michigan and Indiana we have taken it only rarely in the spring and summer in marshes and ponds. In South Dakota, however, the records cover the period from May until September and represent a wide variety of habitats as well as many collections made at lights or by means of light traps.

The specimens from Bennett County were taken or must have had their origin chiefly in fairly fresh water containing very little salt. Much of the material is from the Sand Hills area near Martin. Other collections from South Dakota are mostly from ponds which have resulted from impoundments by dams. These waters are more or less charged with salts, principally magnesium sulphate, calcium sulphate, and calcium carbonate. The concentration of salts varies considerably, from small amounts to concentrations in which fish and most crustaceans are unable to live. When the concentration is very high, a crust of salts forms along the shore and only such plants are present as can tolerate this concentration. It thus seem possible that there may be a correlation with the chemical composition of the water and the degree of elytral and pronotal sculpturing. We may be able to check this supposition by obtaining specimens in the eastern states from salty or alkaline pools, or by rearing them in different types of water.

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## A DEVICE FOR EXPOSING TERGAL AND STERNAL STRUCTURES IN BEES (HYMENOPTERA, APOIDEA)

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In studying bees it has become obvious that certain structures near the bases of the metasomal sclerites, normally hidden by succeeding sclerites, are important for systematic purposes. In particular, the graduli of the second sternum and of the last exposed tergum have proved useful. Also, pygidial plates are usually only partially exposed in dry specimens.

To expose such structures without dimembering the abdomen or irreparably damaging it, a *minute* hook of special design was found useful. The end of a fine needle or pin *(Minuten-Nadeln* or insect pin 000) was bent sharply to form a U-shaped hook at the tip. After mounting in a standard needle holder, the hook was flattened in a press and then sharpened on the convex side to form a blade. This device can be inserted between any terga or sterna, the blade cutting the intersegmental membrane; then the instrument is turned on its axis until the hook will engage the anterior margin of the sclerite which is to be exposed. A gentle pull will expose the sclerite but will not cut it because the concave side of the hook is not sharpened. In damp climates like that of Curitiba, this can usually be done without relaxing specimens; in dry climates a short time in a moist chamber would be required.

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